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SELECTED WATER RESOURCES ABSTRACTS

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As the Nation's principal conservation agency, the Department of the Interior has responsibility for most our our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographic citation and a set of identifiers or descriptors which are listed in the **Water Resources Thesaurus.** Each abstract entry is classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

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To provide SWRA with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas.

The input from these Centers, and from the 54 Water Resources Research Institutes administered under the Water Research and Development Act of 1978, as well as input from the grantees and contractors of the Office of Water Research and Technology and other Federal water resource agencies becomes the information base from which this journal is derived.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology
U.S. Department of the Interior
Washington, D.C. 20240

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SELECTED WATER RESOURCES ABSTRACTS

NATURE OF WATER

1A. Properties

HYDROGEOLOGIC APPRAISAL OF THE KLAMATH FALLS GEOTHERMAL AREA, OREGON,
Geological Survey, Menlo Park, CA. Water Resources Div.
E. A. Sammel.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $3.75. Geological Survey Professional Paper 1044-G, 1980. 45 p, 13 Fig, 4 Plates, 11 Tab, 42 Ref.

Descriptors: *Hydrogeology, *Aquifer characteristics, *Geochemistry, *Geothermal studies, *Oregon, Groundwater, Hot springs, Basalts, Water chemistry, Geophysics, Heat flow, Energy, Resources, Thermal water, *Klamath Falls area(OR).

Geothermal phenomena in the vicinity of Klamath Falls, OR, include hot springs and wells with temperatures that approach 140 C. More than 400 hot wells are used for direct-heat applications. The hot waters occur in basaltic rocks and lacustrine deposits of Miocene to Pleistocene age in close proximity to major Basin and Range faults. Recharge to the geothermal reservoir probably originates in the mildly alkaline calcium bicarbonate water of the local unconfined aquifer system. During its passage through the geothermal reservoir, this water gains dissolved solids up to concentrations of about 900 milligrams per liter; sodium and sulfate become the dominant ions. Most geothermal gradients in the area are strongly influenced by the convective flow of hot water, making them unreliable indicators of depths to the geothermal reservoir. Heat flow in the Lower Klamath Lake basin is about 1.4 microcalories per square centimeter per second (heat flow units), a value near the expected minimum for the Basin and Range province. Net thermal flux from springs and wells is approximately 2,000,000 calories per second. Total convective discharge of heat above the regional datum of 12 C in ground water may be as much as 3,200,000 calories per second. Currently (1978), about 1,400,000 calories per second (6 megawatts) of geothermal heat is beneficially used in the area. On the basis of the quartz geothermometer, isotope analyses, and mixing models, geothermal reservoir temperatures are estimated to be 150 C in two or more separate reservoir zones. The total heat content of the reservoirs is probably in the lower part of the range 15 x 10 to the 18th power to 190 x 10 to the 18th power joules. (USGS).
W80-06359

1B. Aqueous Solutions and Suspensions

BOTTLED WATER: EXPENSIVE GROUND WATER,
Shell Oil Co., New Orleans, LA.
J. R. J. Studlick, and R. C. Bain.
Water Well Journal, Vol 34, No 7, p 15-79, July 1980. 2 Tab.

Descriptors: *Mineral water, *Groundwater, *Chemical analysis, *Taste, Water quality standards, Legal aspects, Bottled water.

Fourteen brands of bottled water, both carbonated and noncarbonated were tested for quality by standard analytical methods and by objective testing. Taste considerations are complex and vary according to individual preferences. However, in terms of mineral content, reliable results were obtained by analytical means. Most of the tested waters met water quality standards. Carbonated waters had the highest mineral content since their deep circulation and high temperatures promote dissolution of minerals from reservoir rocks. California, which accounts for half of the bottled water sold in the United States, has legally defined mineral water as any water containing 500 mg/l of minerals. Thus, some good quality water must delete mineral from its label for sales in California. The word natural may need a legal definition since 80% of the 700 brands of bottled water are not natural but are treated or processed water, usually filtered or distilled well water with man-made carbonation. (Purdin-NWWA).
W80-06422

WATER CYCLE

2A. General

ECOSYSTEM DYNAMICS AND A PHOSPHORUS BUDGET OF AN ALLUVIAL CYPRESS SWAMP IN SOUTHERN ILLINOIS,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
W. J. Mitsch, C. L. Dorge, and J. R. Wiemhoff.
Ecology, Vol 60, No 6, p, 1116-1124, 1979 OWRT A-088-ILL(2), 14-31-0001-7030.

Descriptors: *Swamps, Dendrochronology, *Ecosystems, Sedimentation, *Phosphorus, Illinois, *Alluvial swamp, Biogeochemistry, Nutrient budget, *Phosphorus budget, Riparian ecosystem, Southern Illinois.

Annual patterns in hydrology, phosphorus circulation, and sediment dynamics were studied in a southern Illinois, U.S.A., floodplain swamp dominated by bald cypress (Taxodium distichum) and swamp tupelo (Nyssa aquatica). The study emphasizes the dynamics of the floodplain swamp and correlations of cypress tree growth with flooding and attempts to determine the significance of the interactions between the swamp and the adjacent river. For the study year, major inputs of water ot the swamp were throughfall and runoff with minor contributions due to groundwater. Outflows were by evapotranspiration, surface outflow, and groundwater, with the latter two draining primarily to the river. An annual phosphorus budget was developed for the swamp from field measurements. The deposition of high-phosphorus sediments during the only flood was the greatest input of phosphorus to the swamp. This deposition was 10 times greater than the outflow of phosphorus to the river and 26 times greater than the throughfall input of phosphorus. Total tree uptake from sediments was estimated and duckweed productivity was estimated. For the period 1937-67, cypress growth, based on tree ring analyses, was closely correlated with several measures of flooding frequency and magnitude, all obtained from past river data. Tree ring data prior to 1937 showed poor correlation with flooding, probably because of logging activity. Cypress growth has decreased dramatially in recent years, corresponding to the rise in water level caused by beaver activity.
W80-06254

OPTIMIZED RUNOFF CURVE NUMBERS FOR SUGARCANE AND PINEAPPLE FIELDS IN HAWAII,
Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
K. R. Cooley, and L. J. Lane.
Journal of Soil and Water Conservation, Vol 35, No 3, p 137-141, May-June 1980. 8 Fig, 5 Tab, 9 Ref.

Runoff curve numbers for Hawaiian sugarcane and pineapple fields were derived from actual rainfall-runoff data and used to adjust handbook values. These handbook values were based mainly on experience under mainland conditions and soils. The data-based curve numbers were slighly lower than previously used handbook values for sugarcane. They were considerably lower for pineapple fields where field roads occupied 11-20% of the area. Observations suggest that major portions of the runoff come from road areas and that more intensive conservation measures and maintenance programs for these roads would help reduce this runoff and subsequent erosion. (Sims-ISWS)
W80-06289

CURVE-NUMBER PROCEDURE AS INFILTRATION METHOD,
Science and Education Administration, Columbia, MD. North Central Watershed Research Center.
For primary bibliographic entry see Field 2G.
W80-06301

PROJECTED EFFECTS OF INTERMITTENT CHANGES IN WITHDRAWAL OF WATER FROM THE ARIKAREE AQUIFER NEAR WHEATLAND, SOUTHEASTERN WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
D. T. Hoxie.
Available from OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $5.50 in paper copy, $3.50 in microfiche. Geological Survey open-file report 80-15, 1979. 28 p, 14 Fig, 4 Tab, 8 Ref.

Descriptors: *Computer models, *Surface-groundwater relationships, Hydrogeology, *Aquifer characteristics, *Wyoming, Groundwater, *Withdrawal, Water wells, Irrigation, Industrial water, Water supply, Projections, *Arikaree aquifer(WY), *Southeastern Wyoming, *Withdrawal effects, Water levels, Streamflow.

Effects on streamflows and ground-water levels attributable to a proposed intermittent change in use and sites of withdrawal of 3,146 acre-feet of water from the Arikaree aquifer in central Platte County, WY, are assessed with a previously developed ground-water flow model. This water has been permitted for agricultural use by the State of Wyoming, and under the proposal would supplement, when needed, existing industrial surface- and ground-water supplies for the Laramie River Station of the Missouri Basin Power Project. Under a scenario wherein the supplemental industrial usage occurs in every 10th year commencing in 1980, the model predicts a cumulative streamflow-depletion rate in the Laramie and North Laramie Rivers of 7.7 cubic feet per second in the year 2020 compared to a rate of 6.9 cubic feet per second that is predicted if the intermittent industrial usage does not occur. Areas in which drawdowns relative to the simulated 1973 head configuration exceed 5, 10, 25, and 50 feet are predicted to be 107, 78, 38, and 2 square miles, respectively, in 2020 under the intermittent-usage scenario compared to corresponding areas of 104, 76, 36, and 2 square miles that are predicted if the intermittent industrial usage does not occur. (USGS).
W80-06358

ASYMMETRIC VARIATION OF GHYBEN-HERZBERG LENS,
Rhode Island Univ., Kingston. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2L.
W80-06384

APPLICATION OF THE GREEN-AMPT MODEL TO INFILTRATION UNDER TIME-DEPENDENT SURFACE WATER DEPTHS,
Stanford Univ., CA. Dept. of Civil Engineering.
D. L. Freyberg, J. W. Reeder, J. B. Franzini, and I. Remson.
Water Resources Research, Vol 16, No 3, p 517-528, June 1980. 14 Fig, 32 Ref. NSF ENG76-01271.

Descriptors: *Infiltration, *Surface-groundwater relationships, *Mathematical models, Ephemeral streams, Time, Depth, Saturation, Moisture content, Soil types, Pore pressure, Soil moisture, Equations, Hydraulic conductivity, *Surface water depth, Green-Ampt model, Richards equation.

The performance of the Green-Ampt model for infiltration problems where the depth of water above the ground surface is varying with time was investigated. In order to yield infiltration rates that agree with those predicted by the Richards equation for flow in a homogeneous, nondeforming, and nonhysteretic soil the effective suction head parameter in the Green-Ampt model must be considered a function of time, surface water depth, initial moisture content, and soil type. However, when a constant value of the effective suction head is assumed, the response of the Green-Ampt model to variations in surface water depth is qualitatively equivalent to the response of the Richards model.

The effectiveness of a number of definitions of the suction head parameter that have been proposed in the literature was investigated. While the differences in predicted infiltration rates and cumulative infiltration obtained by using the different definitions are, in general, of marginal significance, the best choice of the value of the effective suction head depends upon the particular problem to which the model is being applied. (Visocky-ISWS).
W80-06399

LONG-TERM ANNUAL SURFACE HEAT AND WATER BALANCES OVER CANADA AND THE UNITED STATES SOUTH OF 60 DEG N: RECONCILIATION OF PRECIPITATION, RUN-OFF AND TEMPERATURE FIELDS,
Toronto Univ. (Ontario). Inst. for Environmental Studies.
F. K. Hare.
Atmosphere-Ocean, Vol 18, No 2, p 127-153, 1980. 12 Fig, 30 Ref, 2 Append.

Descriptors: *Precipitation(Atmospheric), *Runoff, *Temperature, *Canada, *United States, *North America, Water balance, Heat balance, Energy, Evaporation, Air temperature, Atmosphere, Rivers, Streamflow, Discharge(Water), Analytical techniques, Climatology, Hydrology.

This analysis compared the observed field of runoff (assumed correct) with adjusted precipitation over North America (as amended by den Hartog and LeDrew over Canada) and derived the principal hydroclimatological ratios for each five-degree latitude-longitude square. The amended precipitation field yielded values of the Budyko dryness index close to values suggested by the vegetation distribution. The Priestley-Taylor parameter, alpha, lay between unity (equilibrium) and potential (1.26) values over much of humid North America, but exceeded these values in the northwest Pacific squares, where advective heating may be the cause. Other regions of strong seasonal advective heating (e.g., the Great Plains) did not appear to influence the distribution strongly. A weighted convective forcing temperature was derived, varying from 298 K in the extreme south to below 285 K in the north. This function (and the Bowen ratio) achieve improbable values in northern Labrador-Ungava. The precipitation, runoff, and net radiation regimes appeared still to be out of balance in these squares. An adjustment of either precipitation or net radiation by about a tenth corrects the imbalance, but the method was not capable of deciding which field (or both) was in error. Over the rest of the continent the adjusted precipitation field now appeared to be in balance with observed runoff and temperature distributions. (Sims-ISWS).
W80-06404

2B. Precipitation

RAINFALL STORMFLOW ANALYSIS TO INVESTIGATE SPATIAL AND TEMPORAL VARIABILITY OF EXCESS RAINFALL GENERATION,
South Australia Engineering and Water Supply Dept., Adelaide.
R. D. S. Clark.
Journal of Hydrology, Vol 47, No 1/2, p 91-101, may 1980. 7 Fig, 1 Tab, 10 Ref.

Descriptors: *Rainfall, *Rainfall-runoff relationships, *Storm runoff, Spatial distribution, Excessive precipitation, Parametric hydrology, Floods, Statistics, *Stormflow analysis, *Spatial variability, Temporal variability, Excess rainfall generation, Loss rate methods, Catchment rainfall, Extrapolation.

Loss rate methods are still widely used for calculating rainfall excess despite increasing evidence of spatial variability of catchment stormflow generation and awareness that, because of their inherent assumptions of uniform catchment response, these methods may be giving misleading results. A method was described that overcomes this deficiency. By analyzing data sets of catchment rainfall and stormflow only, a parameter statistically quantifying average spatial variability of stormflow generation was obtained. This was then used to derive a set of singular storm progressing loss relationships, the forms of which reflect both generally observed spatial and temporal loss characteristics. The method can be used over the whole range of stormflow prediction and provides a basis for design extrapolation to more severe floods than were recorded. (Roberts-ISWS)
W80-06206

AN ANALYSIS OF THE RECENT EXTREME WINTERS IN THE CONTIGUOUS UNITED STATES,
National Climatic Center, Asheville, NC.
H. F. Diaz, and R. G. Quayle.
Monthly Weather Review, Vol. 108, No 6, 687-699, June 1980. 6 Fig, 5 Tab, 19 Ref.

Descriptors: *Winter, *Temperature, *Precipitation(Atmospheric), *Weather, Data processing, Statistics, Air temperature, Snowfall, Variability, Probability, Seasonal, Meteorology, Climatology, Severe winters, Extreme temperature, Extreme precipitation.

Analysis of monthly mean temperature and precipitation data for each of the 48 contiguous United States for the 1976-77 through 1978-79 winter seasons showed that the temperature and precipitation departures from the long-term means were extreme. The consecutive occurrence of such severely cold winters was unprecedented in the available 85-year record. Variability of temperatures and precipitation has increased in the past 5-year period, compared to previous pentads, mainly as a result of much greater frequency of extreme anonalies. An 'extreme anomaly' was defined as a mean monthly or seasonal value exceeding two standard deviations from the long-term mean. Statistical estimates of average return periods of winter mean temperatures equal to or lower than the actural values recorded for the past three seasons were close to the empirical values. However, the implausibly low probabilities for the occurrence of consecutive severe winters suggested that the development of large-scale anomalies in atmospheric circulation, which these low temperatures represent, may have a common dynamical forcing and that these forcing mechanisms possess time scales on the order of several years. (Sims-ISWS)
W80-06286

AREALLY-WEIGHTED TEMPERATURE AND PRECIPITATION AVERAGES FOR ALASKA, 1931-1977,
National Climatic Center, Asheville, NC.
H. F. Diaz.
Monthly Weather Review, Vol 108, No 6, p 817-822, June 1980. A Fig, 4 Tab, 14 Ref.

Descriptors: *Temperature, *Precipitation(Atmospheric), *Alaska, Weather, Data processing, Analytical techniques, Statistics, Monthly, Seasonal, Correlation analysis, Air temperature, Meteorology, Climatoloy, Average temperatures, Average precipitation.

Areally weighted time series of temperature and precipitation have been compiled for Alaska for the period 1931-77. Correlations of the temperature values with those of the contiguous United States indicate that, at both the monthly and seasonal time scales, the temperatures over the eastern two-thirds of the contiguous United States and Alaska are basically out of phase. However, with regard to long-term trends, the temperatures in both Alaska and the lower 48 states exhibit a similar pattern. (Sims-ISWS)
W80-06287

AN ALTERNATIVE MODEL FOR DRY-SPELL PROBABILITY ANALYSIS,
Instituto Agronomico, Campinas (Brazil).
H. V. De Arrude, and H. S. Pinto.
Monthly Weather Review. Vol 108, No 6, p 823-825, June 1980. 2 Tab, 8 Ref.

Descriptors: *Rainfall, *Variability, *Probability, *Model studies, *South America, Mathematical models, Statistics, Markov processes, Tropical regions, Precipitation(Atmospheric), Weather, Droughts, Climatology, *Brazil, Dry-spell probability.

The occurrence of sequences of dry days in the wet season was studied for six localities scattered over the state of Sao Paulo, Brazil. In order to determine the most suitable probability model for this tropical region, two frequency distribution functions were analyzed: (1) the Markov chain and (2) the truncated negative binomial. In spite of its widespread use, the Markovian model was shown to be less efficient for fitting estimated data with observed data than the truncated negative binomial model. (Sims-ISWS)
W80-06288

A DISTANCE-WEIGHTED METHOD FOR COMPUTING AVERAGE PRECIPITATION,
Regional Engineering Coll, Silichar, (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W80-06291

RECIPROCAL-DISTANCE ESTIMATE OF POINT RAINFALL,
Science and Education Administration, Tucson, AZ. Southwest Rangeland Watershed Research Center.
J. R. Simanton, and H. B. Osborn.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY7, Technical Note, p 1242-1246, July 1980. 1 Fig, 2 Tab, 4 Ref, 1 Append.

Descriptors: *Rainfall, *Estimating, *Analysis, *Rainfall disposition, Analytical techniques, Statistical methods, Correlation analysis, Rain gages, On-site data collections, Point rainfall, Reciprocal distance method.

Accurate estimates of rainfall are most important in hydrologic modeling. Many methods have been suggested to estimate missing or ungaged point rainfall. A reciprocal-distance weighting technique appears to be one of the most accurate. In the reciprocal-distance method, the amount of rainfall at any ungaged point is a function of the measured rainfall and distance to nearby gages. Because of the limited areal extent of thunderstorm rainfall, estimates of rainfall are only accurate if gages are closely spaced. Dean and Snyder found that for widely spaced gages in the Piedmont region of the Southeast, an exponent of 2 in the reciprocal-distance method gave best results. In this paper, the writers attempted to determine if an exponent of 2 would give best results for estimating thunderstorm rainfall in the Southwest and if there were definable relationships among gages, distance, and exponents in the reciprocal-distance method. The reciprocal-distance method gives the greatest weight to the nearest gage and reduces weight proportionally as distance increases and minimizes the smoothing of the rainfall distribution. The reciprocal-distance weighting method was found very useful in estimating missing thunderstorm rainfall data for distances of less than 10 km between gages. Exponents used in testing the weighting equation can range from 1 to 3 without significantly affecting the accuracy of the estimate. (See also W72-05338 and W77-09696) (Humphreys-ISWS).
W80-06296

INVESTIGATIONS OF THE RADAR ECHO CLIMATOLOGY OF SOUTHERN HIPLEX,
Texas A and M Univ., College Station, TX. Dept. of Meteorology.
D. M. Driscoll.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-200587, Price codes: A07 in paper copy, A01 in microfiche. Final report, January 1980. 140 p, 18 Fig, 26 Tab, 16 Ref, 6 Append. 14-90025.

Descriptors: *Climatology, *Synoptic analysis, *Radar, *Meteorology, *Weather patterns, Remote sensing, Convection, Clouds, Air circulation, Cloud physics, Air masses, Analytical tech-

niques, Seasonal, Precipitation (Atmospheric), Texas, Evaluation, Correlation analysis, Cloud seeding, Weather modification.

The synoptic climatology of the Southern HIPLEX region was investigated using both subjective and objective weather classification systems to develop a correction factor for radar bias from PPI films from the Amarillo WSR radar and to determine the effects of seeding on convective cell characteristics. The synoptic climatology data was used to supplement the mesoscale dynamics and cloud physics studies conducted by other scientists. The characterization of the basic atmosphere flow patterns was carried out each day of the four convective seasons (April-September) of 1973-1976 to give variations of pressure, location of fronts, and air temperatures. By careful inspections of 'snapshots' of atmospheric circulation, a synoptic climatology was derived which was subjective in nature and reflected the prior experience of the classifier. The spatial distribution of initial convective echoes had been established by earlier research and the true spatial distribution was determined by applying an empirically derived correction factor for the change of observed echo frequency with distance. The geographic variation of echo occurrances prevented the conclusive comparison of similar data from Midland films. Seeding effects and seeded echoes could not be studied due to an insufficient data base. (Sidney-IPA).
W80-06302

UNUSUAL RAINFALLS IN ILLINOIS,
Illinois State Water Survey, Urbana.
P. G. Vinzani, and S. A. Changnon, Jr.
Weatherwise, Vol 33, No 3, p 124-126, June 1980. 2 Fig, 1 Tab.

Descriptors: *Rainfall, *Variability, *Excessive precipitation, *Moisture deficit, *Illinois, Precipitation (Atmospheric), Rain, Monthly, Weather, Meteorology, Climatology, August rainfall, September rainfall, Extremes.

Rainfall across Illinois in 1979 produced in many areas a record wet August and then a record dry September. This was only the fifth time since 1890 that a record wet month over large areas was followed by record low rains. The in-state distribution of the rain served to accent the extreme contrast between the two months. The areas of the state with the highest August values were in the northern third where record maximum monthly rainfall (8 to 12 inches) occurred at several locations; in turn, this was a part of the area where record low rainfall (trace to 0.1 inch) occurred in September. (Sims-ISWS).
W80-06379

DEVELOPMENT OF A SELF-SEALING RAIN SAMPLER FOR ARID ZONES,
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Inst. for Desert Research.
E. Adar, M. Levin, and A. Barzilai.
Water Resources Research, Vol 16, No 3, p 592-596, June 1980. 5 Fig, 3 Ref.

Descriptors: *Rainfall, *Sampling, *Isotope studies, *Rain gages, Instrumentation, Equipment, Precipitation(Atmospheric), Rain, Storms, Chemicals, Oxygen, Deserts, Arid lands, Arid climates, *Self-sealing rain sampler, *Israel.

Owing to evaporation from standard rain gages in arid zones the natural isotopic abundance of deuterium and oxygen 18 in rainwater may not have been correctly determined in the past. A single-stage rain sampler has been developed involving the use of a hermetic seal to help eliminate the evaporation problem. This gage provides a suitable sample for isotopic analysis. A multiple-stage rain sampler has been developed to enable the collection of successive rainfall fractions within a particular storm. Instruments of both types were distributed throughout the Negev Desert in Israel. Results from 2 years of observations involving 20 storms indicated the efficiency and reliability of the instruments developed. (Sims-ISWS).
W80-06393

LARGE-SAMPLE METHODS FOR DECISION ANALYSIS OF GAMMA VARIATES,
Arizona Univ., Tucson. Dept. of Systems and Industrial Engineering.
R. Krzysztofowicz, and S. Yakowitz.
Water Resources Research, Vol 16, No 3, p 491-500, June 1980. 9 Fig, 6 Tab, 15 Ref, 3 Append. NSF ENG78-09365, ENG76-20280.

Descriptors: *Rainfall, *Frequency, *Model studies, Mathematical models, Computer models, Temporal distribution, Probability, Data processing, Analytical techniques, Statistics, Equations, Mathematics, *Gamma distributions.

It is widely recognized that Bayes decision analysis with gamma variables leads almost invariably to fairly troublesome computational difficulties. The purpose of this paper was to show how these difficulties can be circumvented by the use of certain results of decision theory in conjunction with some specialized developments on series expansions. Specifically, the posterior law was approximated by the computationally and analytically convenient bivariate normal distribution. The approximation technique derived here was compared to exact formulas through statistical measures as well as comparative performance in water resource management contexts. (Sims-ISWS).
W80-06402

LONG-TERM ANNUAL SURFACE HEAT AND WATER BALANCES OVER CANADA AND THE UNITED STATES SOUTH OF 60 DEG N: RECONCILIATION OF PRECIPITATION, RUN-OFF AND TEMPERATURE FIELDS,
Toronto Univ. (Ontario). Inst. for Environmental Studies.
For primary bibliographic entry see Field 2A.
W80-06404

RAINFALL TREND AT PORT MORESBY FROM 1945 TO 1976,
National Weather Service, Papua (New Guinea).
K. Magari.
Weather, Vol 35, No 4, p 110-117, April 1980. 7 Fig, 2 Tab, 7 Ref.

Descriptors: *Rainfall, *Fluctuations, *Coastal plains, Meteorological data, Weather, Seasonal, Monsoons, Topography, Annual, Monthly, *New Guinea, *Meteorological station, Coastal strip, Weather station, Rainfall incidence, Unweighted running means, Seasonal rainfall, Weighted influence, Monsoon shearline.

This study examined the seasonal, annual, and monthly registrations for trends in the rainfall incidence at Port Moresby, situated on the south coast of Papua, New Guinea, from the period of record up to 1976. The study identified several characteristics of rainfall trends: increase in the annual rainfall since the late 1950s and consistent seasonal rainfall, with the north-west season becoming increasingly wetter. In comparison, a study of rainfall in the Seychelles in the Indian Ocean found a marked increase in average rainfall during the south-east season since the late 1950s and a rise in annual rainfall since 1941. High monthly rainfall variability coefficients were also noticeable, ranging from 45-154% as compared to the Seychelles values from 35-78%. (Roberts-ISWS).
W80-06408

2C. Snow, Ice, and Frost

FLOW PATTERNS IN THE CENTRAL NORTH AMERICAN ICE SHEET,
Geological Survey of Canada, Ottawa (Ontario). Terrain Sciences Div.
W. W. Shilts.
Nature, Vol 286, No 5770, p 213-218, July 17, 1980. 3 Fig, 31 Ref.

Descriptors: *Glaciology, *Canada, *Glacial sediments, *Glaciation, Flow, Movement, Stratigraphy, Petrography, Distribution patterns, Till, Glacial soils, *Hudson Bay(Canada), Laurentide ice sheet.

Patterns of glacial dispersal of lithologically distinctive erratics around Hudson Bay show the central portion of the North American Laurentide ice sheet to have been made up of at least two land-based centers, one that grew and dissipated in Keewatin, and one that grew and dissipated in Nouveau Quebec-Labrador. The distance of dispersal along clearly defined flow paths from the centers east and west of Hudson Bay is so great that the time required to form the major erratic trains of the Wisconsinan glaciation may have spanned most of that glacial stage, leaving little time for the development of a major ice dome over Hudson Bay. Hudson Bay received ice flowing from Keewatin and Quebec throughout the last glacial stage. Reconstructions of the palaeoclimatology and dynamics of the Laurentide ice sheet might better be based on the multiple dome model presented rather than on the less complex 'single dome' model. (Humphreys-ISWS).
W80-06376

2D. Evaporation and Transpiration

EFFECTS OF LILY PADS ON EVAPORATION,
Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
K. R. Cooley, and S. B. Idso.
Water Resources Research, Vol 16, No 3, p 605-606, June 1980. 7 Ref.

Descriptors: *Arizona, *Evaporation, *Water loss, *Vegetation effects, Vegetation, Consumptive use, Water tanks, Advection, Crops, Farms, *Lily pads, *Open water, Measurements of evaporation, Vegetative tank, Evaporative water loss, Evaporation reduction, Sensible heat, Advective energy.

Measurements of evaporation from open water and water partially covered by lily pads indicated that for the portion of the surface area covered by lily pads evaporation was reduced to about 84% of that occurring from open water. There has been continuing uncertainty about the effects of vegetation in altering the rate of evaporative water loss from an open water body. This experiment used tanks 2.7 m in diameter and 0.9 m deep, with an inner container 2.1 m in diameter and 0.6 m deep. Since the lily pads laid flat upon the water surface, they were not prone to receive any more advective energy from the air than was the water itself. Although results were obtained on small water bodies in a highly advective environment, they were comparable to those expected for an extensive surface. (Roberts-ISWS).
W80-06392

EVALUATION OF THE BOWEN RATIO/ ENERGY BALANCE METHOD FOR DETERMINING FOREST EVAPOTRANSPIRATION,
British Columbia Univ., Vancouver. Dept. of Soil Science.
D. L. Spittlehouse, and T. A. Black.
Atmosphere-Ocean, Vol 18, No 2, p 98-116, 1980. 6 Fig, 2 Tab, 47 Ref.

Descriptors: *Evapotranspiration, *Forests, *Energy budget, Energy, Temperature, Vapor pressure, Stomata, Resistance, Soil water, *Forest evapotranspiration, *Bowen ratio, Energy balance, Vapor pressure gradients, Psychrometer, Stomatal diffusion, Soil water balance, Eddy correlation.

The Bowen ratio/energy balance method of using periodic reversal of the psychrometers to remove systematic errors was evaluated. Temperature and vapor pressure differences can be measured with accuracies of +0.005 C and +1 Pa, respectively. For a 3-m vertical separation of the psychrometers and the Bowen ratio, the probable relative error in the forest evapotranspiration was less than +15% when the temperature and vapor pressure gradients were large, and ranged from +10 to +60% when the gradients were small. The error in evapotranspiration was from two to five times these values when the Bowen ratio was less than zero. Measurements of evapotranspiration made with the Bowen ratio/energy balance method were compared with those made concurrently with an eddy correlation/energy balance method, a stomatal dif-

fusion resistance method, and a soil water balance method. Agreement was generally within +20% and frequently within +10%, well within the errors associated with the methods. (Roberts-ISWS).
W80-06405

2E. Streamflow and Runoff

THE SPATIAL DIMENSION IN THE INTERPRETATION OF STREAM SOLUTE BEHAVIOUR,
Exeter Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 2K.
W80-06203

RAINFALL STORMFLOW ANALYSIS TO INVESTIGATE SPATIAL AND TEMPORAL VARIABILITY OF EXCESS RAINFALL GENERATION,
South Australia Engineering and Water Supply Dept., Adelaide.
For primary bibliographic entry see Field 2B.
W80-06206

A CONTINUOUS STREAMFLOW MODEL,
Natal Univ., Durban (South Africa). Dept. of Civil Engineering.
G. G. S. Pegram.
Journal of Hydrology, Vol 47, No 1/2, p 65-89, May 1980. 9 Fig, 1 Tab, 18 Ref.

Descriptors: *Streamflow, *Watersheds(Basins), *Runoff, *Model studies, Mathematical models, Drainage, Infiltration, Channel flow, Inflow, Discharge(Water), Rainfal, Precipitation(Atmospheric), Hydrographs, Synthetic hydrology, Hydrology.

Making the assumption that a moderately large catchment can be modeled as a combination of linear reservoirs in series and in parallel where the effective precipitation is a compound Poisson process, the author presened relationships between the paramters of the catchment model, the discretely coincident model (shown to be ARMA with a special structue), and the continous model. Exploiting the structure that derives from the specification, the author suggested an estimation procedure and applied it to an actual streamflow record. Preliminary results were very encouraging. (Sims-ISWS)
W80-06207

RANGE ANALYSIS FOR RESERVOIR STORAGE WITH INDEPENDENT INFLOWS,
Asian Inst. of Tech., Bangkok (Thailand).
H. N. Phien, A. Arbhabhirama, and P. Sutabutr.
Journal of Hydrology, Vol 47, No 1/2, p 53-64, May 1980. 2 Fig, 2 Tab, 8 Ref.

Descriptors: *Reservoirs, *Storage, *Model studies, Mathematical models, Inflow, Reservoir storage, Storage capacity, Equations, Theoretical analysis, Analytical techniques, Surplus water, Hydrology.

Range analysis was used to investigate the storage problem of an infinite reservoir where the annual inflows were independent and identicaly distributed either as normal or as gamma variables. The distribution of the water content in the reservoir for a specified year was derived and given in a closed form. The first few moments of the maximum amounts of water in surplus and in deficit over the reservoir life were obtained, and their distributions were approximated by the Pearson type-I curve. The distribution of the reservoir storage capacity was approximated by the type-III curve which was completely determined by its first two moments. In addition, it was found that when the skewness coefficient of the inflows increases: (1) the maximum amount of water in surplus fluctuates more and approaches the zero value more frequently, while that in deficit fluctuates less and approaches the zero value less frequently; and (2) the reservoir size becomes smaller but its distribution becomes less stable. (Sims-ISWS)
W80-06208

GAMMA SYNTHETIC HYDROGRAPHS,
Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
T. E. Croley, II.
Journal of Hydrology, Vol 47, No 1/2, p 41-52, May 1980. 1 Fig, 1 Tab, 15 Ref.

Descriptors: *Synthetic hydrology, *Hydrographs, *Model studies, Mathematical models, Theoretical analysis, Analytical techniques, Runoff, Storm runoff, Design storm, Design flood, Watersheds(Basins), Flow, Hydrology, Gamma distributions.

The two-parameter Gamma distribution was presented as a basis for synthetic hydrographs with a review of existing applications, and nonfeasible applications were identified. Several approaches for fitting this function to practical boundary condition parameters were identified and presented in a unified treatment. They were especially designed for use on small programmable calculators since the synthetic hydrograph is extremely sensitive to the Gamma distribution parameters. Nomographs would give large errors in the fit for small errors in the boundary condition parameters. Although nondimensionalization of the synthetic hydrograph is possible with the Gamma distribution, it was shown to be unnecessary. Current uses of 'standard' nondimensional hydrographs were shown to be in error. (Sims-ISWS)
W80-06209

STOCHASTIC GENERATION OF MONTHLY FLOWS FOR EPHEMERAL STREAMS,
Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
R. Serikanthan, and T. A. McMahon.
Journal of Hydrology, Vol 47, No 1/2, p 19-40, May 1980. 6 Fig, 7 Tab, 8 Ref.

Descriptors: *Ephemeral streams, *Streamflow, *Mathematical models, *Model studies, Flow, Low flow, Analytical techniques, Methodology, Stochastic processes, Monthly, Runoff, Rivers, River flow, Hydrology, *Zero flows.

Six procedures for generating monthly flows of ephemeral streams were discussed and applied to eight Australian rivers. Based on the results the method of fragments was recommended, although several other procedures yielded satisfactory results. Procedures examined included that of Beard, three variations of the log-normal distribution, the two-tier model, and the method of fragments. (Sims-ISWS)
W80-06210

AN AUTOCORRELATION APPROACH FOR PARAMETER ESTIMATION OF FRACTIONAL ORDER EQUAL-ROOT AUTOREGRESSIVE MODELS USING HYPERGEOMETRIC FUNTIONS,
Indian Inst. of Tech., New Delhi. Dept. of Civil Engineering.
S. K. Spolia, S. Chander, and K. M. O'Conner.
Journal of Hydrology, Vol 47, No 1/2, p 1-17, may 1980. 25 Ref, 2 Append.

Descriptors: *Runoff, *Reservoirs, *Model studies, *Mathematical models, Analytical techniques, Mathematics, Regression analysis, Correlation analysis, Storms, Storm runoff, Hydrographs, Equations, Hydrology, Autoregressive models, Paramter estimation.

A method of estimating the parameters of an autoregressive model with real and equal roots in its characteristic equation was developed. The proposed method uses the serial autocorrelation function in the estimation process. Unlike solution of Yule-Walker equations, this method does not require an a priori knowledge of the order of the model and is not restricted to integer order models. The possible use of this method in estimating the parameters of an autoregressive cum moving average model and those of the continuous cascade model of linear and equal reservoirs was indicated. (Sims-ISWS)
W80-06211

MAXIMUM-LIKELIHOOD ESTIMATION OF THE GENERAL EXTREME-VALUE DISTRIBUTION PARAMETERS,
Agricultural Univ., Wageningen (Netherlands). Dept. of Mathematics.
A. Otten, and M. A. J. Van Montfort.
Journal of Hydrology, Vol 47, No 1/2, p 187-192, May 1980. 1 Tab, 3 Ref.

Descriptors: *Mathematical models, *Model studies, *Estimating equations, *Mathematics, Equations, Theoretical analysis, Analytical techniques, Statistics, Statistical models, Hydrology, Synthetic hydrology, Extreme values.

Some modifications of Jenkinson's procedure for getting ML-estimtes of the GEV-distribution were proposed in order to reduce both the number of iterations and the probability of the procedure failing. (Sims-ISWS)
W80-06217

COMPARISON OF BED FORM VARIANCE SPECTRA WITHIN A MEANDER BEND DURING FLOOD AND AVERAGE DISCHARGE,
South Carolina Univ., Columbia. Dept. of Geology.
For primary bibliographic entry see Field 2J.
W80-06245

BOUNDARY LAYERS IN DEVELOPING OPEN CHANNEL FLOW,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
For primary bibliographic entry see Field 8B.
W80-06297

BAYESIAN FREQUENCY ANALYSIS,
Illinois Univ., at Urbana-Champaign. Dept. of Civil Engineering.
W. H. Tang.
Journal of the Hydraulics Division, Amerian Society of Civil Engineers, Vol 106, No HY7, Proceedings Paper 15532, p 1203-1218, July 1980. 4 Fig, 5 Tab, 10 Ref, 3 Append. NSF ENG 7808392.

Descriptors: *Frequency analysis, *Analytical techniques, *Mathematical models, *Hydrology, Regression analysis, Analysis, Statistics, *Floods, Probability, Risks, Discharge(Water), Frequency, Mathematical studies, Theoretical analysis, Statistical methods, Design flow, Design flood, Bayes theorem.

The traditional frequency analysis attempts to fit a specific probability model on the basis of limited data, from which the flood level corresponding to a given return period is determined. Because of: (1) scatter of observed data about the theoretical probability model, (2) uncertainty of extrapolation from limited measured record, and (3) uncertainty in selecting the correct model, the flood level corresponding to a given return period should be a random variable. This paper developed formulas for predicting the design flood value and evaluation the uncertainty associated with the prediction for a specifically chosen probability model and for a given return period. A procedure was developed that will yield an estimate of the design flood through systematically incorporating predictions from several vying models. Bayesian statistics wre applied to incorporate the model uncertainty in the evaluation of hydrologic risk over the life-time of a hydraulic system. (Humphreys-ISWS)
W80-06298

AN APPROACH TO MARGINAL ECONOMIC ANALYSIS OF HYDROMETRIC DATA COLLECTION,
Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7A.
W80-06310

A MODEL FOR FLOODPLAIN MANAGEMENT IN URBANIZING AREAS,
Illinois Univ. at Urbana-Champaign. Inst. for Environmental Studies.
For primary bibliographic entry see Field 4A.
W80-06319

BACKWATER AT BRIDGES AND DENSELY WOODED FLOOD PLAINS, WEST FORK AMITE RIVER NEAR LIBERTY, MISSISSIPPI,
Geological Survey, Jackson, MS, Water Resources Div.
For primary bibliographic entry see Field 6A.
W80-06348

BACKWATER AT BRIDGES AND DENSELY WOODED FLOOD PLAINS, THOMPSON CREEK NEAR CLARA, MISSISSIPPI,
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 6A.
W80-06353

WATER AVAILABILITY AND FLOOD HAZARDS IN THE JOHN DAY FOSSIL BEDS NATIONAL MONUMENT, OREGON,
Geological Survey, Portland, OR. Water Resources Div.
F. J. Frank, and E. A. Oster.
Available from OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $5.25 in paper copy, $4.00 in microfiche. Geological Survey open-file report 79-1487 (WRI), 1979. 28 p, 12 Fig, 1 Plate, 3 Tab, 7 Ref.

Descriptors: *Groundwater availability, *Flood forecasting, *Flash floods, *Oregon, *Hydrogeology, Alluvium, Streams, Water wells, Water supply, National parks, Recreation, Camp sites, Springs, Water quality, Chemical analysis, Flood flow, Flood frequency, John Day River(OR), *John Day Fossil Beds National Monument area(OR), Slope conveyance.

The rock formations of the John Day Fossil Beds National Monument area are aquifers that can be expected to yield less than 10 gallons of water per minute to wells. The most permeable of the geologic units is the alluvium that occurs at low elevations along the John Day River and most of the smaller streams. Wells in the alluvial deposits can be expected to yield adequate water supplies for recreational areas; also, wells completed in the underlying bedrock at depths ranging from 50 to 200 feet could yield as much as 10 gallons per minute. Pumping tests on two unused wells indicated yields of 8 gallons per minute and 2 gallons per minute. Nine of the ten springs measured in and near the monument area in late August of 1978 were flowing 0.2 to 30 gallons per minute. Only the Cant Ranch spring and the Johnny Kirk Spring near the Sheep Rock unit had flows exceeding 6 gallons per minute. Chemical analyses of selected constituents of the ground water indicated generally low concentrations of dissolved minerals. Although cloudbursts in the Painted Hills unit could generate a flood wave on the valley floors, flood danger can be reduced by locating recreational sites on high ground. The campground in Indian Canyon of the Clarno unit is vulnerable to cloudburst flooding. About 80 percent of the proposed campground on the John Day River in the Sheep Rock unit is above the estimated level of 1-percent chance flood (100-year flood) of the river. The 1-percent chance flood would extend about 120 feet from the riverbank into the upstream end of the campground. (USGS).
W80-06354

SOURCE AREAS OF SALINITY AND TRENDS OF SALT LOADS IN STREAMFLOW IN THE UPPER COLORADO RIVER, TEXAS,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 5B.
W80-06357

PEAK RUNOFF FROM SMALL AREAS -- A KINEMATIC APPROACH,
University of the Witwatersrand, Johnannesburg (South Africa). Dept. of Civil Engineering.
D. Stephenson.
Water SA (Pretoria), Vol 6, No 2, p 59-65, April 1980. 9 Fig, 1 Tab, 14 Ref.

Descriptors: *Runoff, *Kinetics, *Peak discharge, *Parametric hydrology, *Water loss, *Runoff forecasting, Mathematical studies, Rainfall intensity, Rainfall-runoff relationship, Discharge(Water), Slopes, Surface waters, Urbanization, Flow, Friction, Movement, Watershed(Basins), Frequency, Model studies, Correlation analysis, Physical properties, Flow duration, Time lag, Hydrology, Infiltration, Overland flow, South Africa.

The kinematic approximation of simplified St. Venant hydrodynamic equations was used to mathematically analyze storm runoff in several South African locations. The kinematic approach has the advantage that all the variables can be physically measured, such as slope roughness, and length of catchment. Head losses can be estimated by the Manning-Strickler equation. Two loss models are presented, one where losses are assumed to occur in the beginning of the storm (catchment storage), and another where there is a uniform loss throughout the storm. Equations for the time of concentration for overland flow were derived for each model and compared to the rainfall intensity-duration-frequency data in several South African areas under different conditions. Regional parameters are given so that concentration times and peak runoffs for different areas can be read off charts. Additional loss function variables are discussed: surface losses (infiltration), roughness, canalization, and urbanization. The results are dimensionless so that the rainfall figures are applicable worldwide. (Sidney-IPA).
W80-06369

STREAMFLOW AND RESERVOIR-CONTENT RECORDS IN TEXAS, COMPILATION REPORT, JANUARY 1889 THROUGH DECEMBER 1975,
Texas Dept. of Water Resources, Austin.
For primary bibliographic entry see Field 7C.
W80-06375

DETENTION STORAGE FOR URBAN FLOOD CONTROL.
Espey Huston and Associates, Inc., Dallas, TX.
D. P. Smith, Jr., and P. B. Bedient.
Journal of the Water Resources Planning and Management Division, American Society of Civil Engineers, Vol 106, No WR2, Proceedings Paper 15555, p 413-425, July 1980. 4 Fig, 6 Tab, 17 Ref, 2 Append.

Descriptors: Land use, *Urban runoff, *Reservoirs, *Flood control, *Water storage, Drainage, Computer models, Urban hydrology, Runoff, Urban drainage, *Detention reservoirs, Rainfall, Model studies, Detention storage.

A method for evaluating effects of detention storage in urban watersheds was presented. Effects of rainfall frequency, land use condition, and storage policy were directly considered as they alter downstream flows. The U.S. Army Corps of Engineers HEC-1 model formed the basic tool for calibration of flood flows on two recent storms on Brays Bayou in Houston, Texas. A storage detention model was used along with empirical unit hydrographs in HEC-1 to predict design flows for both existing land use and projected future developments. (Lee-ISWS).
W80-06388

KINEMATIC WAVE ROUTING INCORPORATING SHOCK FITTING,
Mississippi Univ. Dept. of Civil Engineering.
D. K. Borah, S. N. Prasad, and C. V. Alonso.
Water Resources Research, Vol 16, No 3, p 529-541, June 1980. 13 Fig, 1 Tab, 20 Ref.

Descriptors: *Streamflow, *Hydrographs, *Waves(Water), *Model studies, Mathematical models, Runoff, Precipitation(Atmospheric), Watersheds(Basins), Agricultural watersheds, Inflow, Discharge(Water), Overland flow, Hydrology, *Kinematic wave routing, Shock waves, Lateral inflow, Flow routing.

An analytical solution to the kinematic wave approximation for unsteady flow routing was presented. The model allows time-dependent lateral inflow with piecewise spatial uniformity and can be applied to complex kinematic cascades. Kinematic shocks were considered as manifestations of higher-order effects such as monoclinal flood waves, bores, etc. Within the context of kinematic approximation therefore the authors retain their dynamic effects by routing the discontinuities as they appear. Certain simplifying assumptions are made that permit closed form solutions, and an efficient numerical algorithm, based on the method of characteristics, is employed. The resulting model, called an approximate shock-fitting scheme, preserves the effect of the shocks without the usual computational complications and compares favorably with an implicit finite difference solution. The efficiency and accuracy of the new method were illustrated by computing a variety of unsteady flows, ranging from simple cascades to complex natural watersheds. (Sims-ISWS).
W80-06398

CHOOSING AMONG HYDROLOGIC REGRESSION MODELS, 2. EXTENSIONS TO THE STANDARD MODEL,
Universidad Simon Bolivar, Caracas (Venezuela). Graduate Program in Hydrology and Water Resources.
J. B. Valdes, I. Rodriguez-Iturbe, and G. J. Vicens.
Water Resources Research, Vol 16, No 3, p 507-516, June 1980. 4 Fig, 3 Tab, 11 Ref. NSF GK-41643X.

Descriptors: *Hydrologic data, *Regression analysis, *Model studies, *Mathematical models, Synthetic hydrology, Mathematics, Equations, Probability, Statistics, Methodology, Analytical techniques, Hydrology.

Bayesian methods were used to discriminate among alternative structures of the covariance matrix of the disturbances of hydrologic regression schemes; moreover, the covariance matrix was allowed to be nonscalar. Different alternative functional forms, which the hydrologic regression may also have, were also discriminated through the proposed methodology. (Sims-ISWS).
W80-06400

SYSTEM MODEL OF DAILY SEDIMENT YIELD,
National Council for Scientific Research, Lusaka (Zambia).
For primary bibliographic entry see Field 2J.
W80-06401

LONG-TERM ANNUAL SURFACE HEAT AND WATER BALANCES OVER CANADA AND THE UNITED STATES SOUTH OF 60 DEG N: RECONCILIATION OF PRECIPITATION, RUN-OFF AND TEMPERATURE FIELDS,
Toronto Univ. (Ontario). Inst. for Environmental Studies.
For primary bibliographic entry see Field 2A.
W80-06404

HYPSOMETRIES OF MICHIGAN'S SOUTHEASTERN LAKE PLAIN,
Michigan Univ., Ann Arbor. Dept. of Geography.
E. N. Bannister.
Journal of Great Lakes Research, Vol 6, No 2, p 154-163, 1980. 6 Fig, 1 Tab, 6 Ref.

Descriptors: *Hypsometric analysis, *Lake Huron, *Watersheds(Basins), *Water levels, *Surface drainage, Areal, Elevation, Height, Analytical techniques, Lake morphology, Topographic mapping, Glaciology, Glacial sediments, Drainage, Drainage area, Drainage patterns(Geologic), Dimensions, Drainage density, Geologic control, Rivers, Shores, Lake stages, Terraces(Geologic).

The geometric character of the surface drainage basins of Michigan's southern Lake Huron coastal

fringe were studied through the morphological history of the region, basin hypsometric attitudes, and basin aerial and planform dimensions. The drainage basins were forced to adjust to several changes in lake levels during the postglacial period and this adjustment is evident through hypsometric analysis (the graph of the relation between planform basin area and corresponding basin attitude). One hundred sixteen drainage basins were delimited on the region's U.S.G.S. 1 to 24,000 topographic maps and the basins were classified by the shapes of their hypsometric curves. Basins whose development depended on lake levels below that of modern Lake Huron (581 feet/177 meters) have mean integral values of .3986 (SD=.0244); presently adjusting, .04854 (SD=.0320); and presently developing out of interbasin divides have values of .5866 (SD=.0392). The geometry of the basins is impacted by the landscape of the glacial moraine and the geometries are not always the result of fluvial activity alone. Basin hypsometry is dominated by the geometry of the glacio-lacustrine surface. (Sidney-IPA).
W80-06445

WIND STRESS EFFECTS ON DETROIT RIVER DISCHARGES,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
F. H. Quinn.
Journal of Great Lakes Research, Vol 6, No 2, p 172-175, 1980. 4 Fig, 1 Tab, 4 Ref.

Descriptors: *Mathematical models, *Winds, *Water levels, *Discharge(Water), *River flow, Dynamics, Flow profiles, Wind tides, Surges, Storms, Ice, Seasonal, Stress, Waves(Water), Turbulence, Wind velocity, Water level fluctuations, Evaluation, Analysis, Water balance, Lakes, Equations, Estimating equations, Momentum equation, Synoptic analysis, Detroit River, Lake St. Clair.

Mathematical models for the dynamic flow of the Detroit River were modified to include terms expressing surface wind stress and then used to calculate the effects of wind stress on the daily and monthly discharges of the river. The effects of ice, wind, and storms can also be analyzed with these one-dimensional equations of continuity and momentum. The calculated discharges were analyzed using synoptic wind and hourly water level data for 1977. Large differences between upper and total river models occurred during the winter due to severe ice conditions in the river. The addition of wind stress terms into the mathematical models did not effect the monthly or daily flow calculations to any great extent. The average monthly wind effect of minus 47 cubic meters per second is about 111 millimeters depth of water per month on Lake St. Clair and this effect is significant for some Lake St. Clair water balance studies. Lake Erie is affected by 5 millimeters of depth per month and this is not significant. Daily and hourly flow calculations are affected by wind speeds in excess of about 6 meters per second and wind stress terms should be included in the calculations in such cases. (Sidney-IPA).
W80-06448

2F. Groundwater

PUBLIC POLICY FOR THE MANAGEMENT OF GROUNDWATER IN THE COASTAL PLAIN OF NORTH CAROLINA,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 4B.
W80-06221

ESTIMATING RECHARGE TO THE GROUNDWATER RESERVOIR IN SUFFOLK COUNTY, NEW YORK BY MEASURING SOIL WATER FLOW,
Cornell Univ., Ithaca, NY. Dept. of Agricultural Engineering.
T. Steenhuis, W. H. Brutsaert, J. A. Frizzola, L. A. Jacobowitz, and B. A. Ringers.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-211246, Price codes: A04 in paper copy, A01 in microfiche. Research Project Technical Completion Report, September 1979. 64 p, 17 Fig, 6 Tab, 28 Ref, 4 Append. OWRT B-059-NY(1). 14-34-0001-7171.

Descriptors: *Groundwater recharge, *Soil water, *Soil physical properties, *Tensiometers, *Soil water movement, *Neutron activation analysis, Water pollution sources, Farm wastes, Water supply, New York, Conductivity, Darcys equation, Percolating water, Hydrologic budget, Regression analysis, Fertilizers, Pesticides.

Experimental and theoretical methods for the determination of groundwater recharge were investigated in eastern Long Island, New York. Recharge is the amount of water that percolates through the unsaturated soil to join the groundwater and this has been contaminated by fertilizers and pesticides in the Long Island area. The vertical flux was estimated by using data from tensiometers and neutron probes to give matric potential and soil moisture content, respectively, and substituting values into the Darcy equation. Conductivity was measured in-situ and in the laboratory by the crust method and the rapid method. Regression analysis of the data afforded the dependence of conductivity to moisture content and matric potential. The data indicate that the hydrologic budget may be closed, but measurement of recharge in winter was difficult due to the freezing of water in the tensiometers. The techniques employed were useful for research in the sandy soil on Long Island, but they cannot be recommended for routing analyses because the measurements were difficult, time-consuming, and required a skilled technician for neutron probe measurements. (Sidney-IPA)
W80-06226

GROUND-WATER DATA FOR MICHIGAN 1978,
Geological Survey, Lansing, MI. Water Resources Div.
G. C. Huffman.
OFSS, Box 25425, Fed. Ctr., Denver, CO 80225. Paper copy $8.25. Microfiche $3.50. Geological Survey open-file report 80-2, 1979. 61 p, 5 fig, 3 tab, 116 ref.

Descriptors: *Groundwater resources, *Michigan, *Water levels, *Aquifers, *Water quality, Well data, Water wells, Water yield, Aquifers, Water level fluctuations, Water utilization, Water quality, Water analysis, Chemical analysis, Hydrographs.

This report for Michigan summarizes data on ground-water levels in 143 observation wells, and provides information on well locations, depths, altitudes, and aquifers that they tap. Tabulated data include extremes of water levels for 1978 and for the period of record. Also tabulated is the pumpage of most major ground-water users in the State and quality data on selected wells sampled during 1978. Ground-water levels followed precipitation trends in most areas. Above normal precipitation in the upper peninsula and southwestern lower peninsula resulted in above average ground-water levels at years end in those areas. Elsewhere levels were generally below average. (USGS).
W80-06242

GROUND WATER IN THE MYRTLE CREEK-GLENDALE AREA, DOUGLAS COUNTY, OREGON,
Geological Survey, Portland, OR. Water Resources Div.
F. J. Frank.
Geological Survey Water-Resources Investigations 79-8 (open-file report), 1979. 2 Sheets, 7 Ref.

Descriptors: *Groundwater availability, *Aquifer characteristics, *Groundwater resources, Water quality, Oregon, Water yield, Water wells, Water-level fluctuations, Well data, Chemical analysis, Irrigation, Hydrogeology, Maps, *Myrtle Creek-Glendale area(OR), *Douglas County(OR).

This report describes briefly the occurrence of ground water and presents ground-water information that will help water users, public officials, and planners to determine the probability of obtaining adequate quantities of good-quality ground water in the Myrtle Creek-Glendale area, Douglas County, Oreg. The area covers about 400 square miles in southwestern Oregon. Although the geologic formations of the area have low permeabilities and generally yield small amounts of water to wells, ground water is the chief source of water for domestic use in rural parts of the area not served by public supplies. A well capable of yielding 5 to 10 gal/min is generally adequate for a household. Where a suitable storage facility can be provided, yields of less than 5 gal/min can supply household needs. In most places in the area, the quantities of water obtainable from wells are inadequate or would be only marginally adequate for irrigation, municipal, or large industrial use. Included are maps showing a real geology, locations and chemical diagrams of wells with water analysis, ranges and medians of depth to water and depth to wells, and median yield capabilities of existing wells. Also included is a table listing chemical analysis of water. (USGS).
W80-06248

AVAILABILITY OF GROUND WATER IN THE LOWER CONNECTICUT RIVER BASIN, SOUTHWESTERN NEW HAMPSHIRE,
Geological Survey, Concord NH. Water Resources Div.
For primary bibliographic entry see Field 7C.
W80-06249

A STATISTICAL APPROACH TO THE INVERSE PROBLEM OF AQUIFER HYDROLOGY: 2. CASE STUDY,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
S. P. Neuman, G. E. Fogg, and E. A. Jacobson.
Water Resources Research, Vol. 16, No. 1, p 33-58, February 1980. 25 Fig, 1 Tab, 25 Ref. OWRT A-097-ARIS(1), 14-34-0001-0103.

Descriptors: *Aquifers, *Hydrology, *Model studies, *Statistics, *Arizona, Mathematical models, Finite element analysis, Groundwater, Groundwater movement, Transmissivity, Pumping, Water levels, Recharge, Natural recharge, Hydrogeology, Aquifer characteristics, Hydrogeology, *Tucson Basin (AZ).

In part 1 of this paper a new, statistically based approach to the problem of estimating spatially varying aquifer transmissivities on the basis of steady state water level data was presented. Part 2 described a case study in which the new method is applied to actual field data from the Cortaro Basin in southern Arizona. The paper did not present a perfect example of how the new inverse method should be used but only a preliminary demonstration of some of its capabilities in dealing with realistic data. The estimated transmissivities were shown to compare favorably with those obtained earlier for the same basin by an ad hoc trial-and-error procedure. Both sets of transmissivity values have been used successfully in conjunction with a mixed explicit-implicit finite element model to reproduce 25 years of water level variations in the Cortaro Basin in response to pumpage during the period 1940-1965. The finite element model has revealed some important features of the local hydrogeological regime which have not been recognized previously. (Sims-ISWS).
W80-06251

A HYDROGEOCHEMICAL SURVEY OF THE CHALK GROUNDWATER OF THE BANSTEAD AREA, SURVEY, WITH PARTICULAR REFERENCE TO NITRATE,
Water Research Centre, Marlow (England). Resources Div.
For primary bibliographic entry see Field 5B.
W80-06285

DRINKING WATER QUALITY AND VARIATIONS IN WATER LEVELS IN THE FRACTURED CRYSTALLINE-ROCK AQUIFER, WEST-CENTRAL JEFFERSON COUNTY, COLORADO,

Geological Survey, Lakewood, CO, Water Resources Div.
D. C. Hall, and C. J. Johnson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-128580, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water Resources Investigations 79-94, September 1979. 52 p, 8 Fig, 11 Tab, 36 Ref.

Descriptors: *Potable water, *Water quality, Water levels, *Groundwater, *Colorado, Aquifer characteristics, Bacteria, Trace elements, Radioactivity, Water analysis, Specific conductivity, Observation wells, Water level fluctuations, Hydrographs, *Jefferson County(CO), *Fractured crystalline-rock aquifer(CO).

In parts of Jefferson County, CO, water for domestic use from the fractured crystalline-rock aquifer contained excessive concentrations of major ions, coliform bacteria, trace elements, or radiochemicals. Based on results of analyses from 26 wells, water from 21 of the wells contained excessive concentrations of one or more constituents. Drinking water standards were exceeded for fluoride in water from 2 wells, nitrate plus nitrite in 2 wells, dissolved solids in 1 well, iron in 6 wells, manganese in 8 wells, zinc in 2 wells, coliform bacteria in 4 wells, gross alpha radiation in 11 wells and possibly 4 more, and gross beta radiation possibly in 1 well. Local variations in concentrations of 15 chemical constituents, specific conductance, and water temperature were statistically significant. Specific conductance increased significantly during 1973-75 only in the vicinity of Indian Hills. Annual range in depths to water in 11 observation wells varied from 1 to 15 feet. The shallowest water levels were recorded in late winter, usually in February. The deepest water levels occurred during summer or fall, depending on the well and the year. Three-year trends in water level changes in 6 of the 11 wells indicated decreasing water storage in the aquifer. (USGS).
W80-06343

WATER AVAILABILITY AND FLOOD HAZARDS IN THE JOHN DAY FOSSIL BEDS NATIONAL MONUMENT, OREGON,
Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 2E.
W80-06354

FINITE-DIFFERENCE MODEL TO SIMULATE THE AREAL FLOW OF SALT WATER AND FRESH WATER SEPARATED BY AN INTERFACE,
Geological Survey, Reston, VA. Water Resources Div.
J. W. Mercer, S. P. Larson, and C. R. Faust.
Available from OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $11.75 in paper copy, $3.50 in microfiche. Geological Survey open-file report 80-407, April 1980. 58 p, 8 Fig, 4 Tab, 10 Ref.

Descriptors: *Computer models, *Simulation analysis, *Saline water-fresh water interfaces, *Groundwater movement, Flow characteristics, Aquifer characteristics, Model studies, Equations, *Finite-difference techniques, *Two-dimensional model.

Model documentation is presented for a two-dimensional (areal) model capable of simulating ground-water flow of salt water and fresh water separated by an interface. The partial differential equations are integrated over the thicknesses of fresh water and salt water resulting in two equations describing the flow characteristics in the areal domain. These equations are approximated using finite-difference techniques and the resulting algebraic equations are solved for the dependent variables, fresh water head and salt water head. An iterative solution method was found to be most appropriate. The program is designed to simulate time-dependent problems such as those associated with the development of coastal aquifers, and can treat water-table conditions or confined conditions with steady-state leakage of fresh water. The program will generally be most applicable to the analysis of regional aquifer problems in which the zone between salt water and fresh water can be considered a surface (sharp interface). Example problems and a listing of the computer code are included. (USGS).
W80-06356

HYDROGEOLOGIC APPRAISAL OF THE KLAMATH FALLS GEOTHERMAL AREA, OREGON,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 1A.
W80-06359

APPROXIMATE WATER-LEVEL CHANGES IN WELLS IN THE CHICOT AND EVANGELINE AQUIFERS IN THE HOUSTON-GALVESTON REGION, TEXAS, 1977-80 AND 1979-80,
Geological Survey, Houston, TX. Water Resources Div.
For primary bibliographic entry see Field 7C.
W80-06360

WATER TABLE IN THE HIGH PLAINS AQUIFER IN 1978 IN PARTS OF COLORADO, KANSAS, NEBRASKA, NEW MEXICO, OKLAHOMA, SOUTH DAKOTA, TEXAS, AND WYOMING,
Geological Survey, Lakewood, CO. Water Resources Div.
E. D. Gutentag, and J. B. Weeks.
Available from OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $3.50 in paper copy, $ .50 in microfiche. Geological Survey open-file report 80-50, March 1980. 1 Sheet, 10 Ref.

Descriptors: *Great Plains, *Water table, *Aquifer characteristics, *Groundwater, Water levels, Irrigation, Water wells, Quaternary Period, Tertiary Period, Geologic units, Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, Wyoming, *High Plains aquifer.

The High Plains aquifer includes an area of about 177,000 square miles, with 74 percent of the area in Kansas, Nebraska, and Texas, and 26 percent of the area in Colorado, New Mexico, Oklahoma, South Dakota, and Wyoming. The High Plains aquifer consists of one or more hydraulically connected geologic units of late Tertiary or Quaternary age. The late Tertiary rocks consist of the Brule Formation, Arikaree Group, and Ogallala Formation. The Quaternary rocks consist of alluvial, dune-sand, and valley-fill deposits. The configuration of the water table indicates that the High Plains aquifer is continuous throughout its extent, ground water generally flows west to east, and areas overlain by dune sand are recharge areas. Discharge from the aquifer is primarily to wells and streams. (USGS).
W80-06361

GROUND-WATER STATUS REPORT, PEARL HARBOR AREA, HAWAII, 1978,
Geological Survey, Honolulu, HI. Water Resources Div.
R. L. Soroos, and C. J. Ewart.
Available from OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $11.00 in paper copy, $1.50 in microfiche. Geological Survey open-file report 79-1542, (WRI), 1979. 3 Sheets, 8 Ref.

Descriptors: *Groundwater basins, *Water demand, *Freshwater, *Hawaii, Aquifers, Withdrawal, Chlorides, Maps, Hydrographs, *Pearl Harbor area(HI), *Island of Oahu(HI), Water-level declines.

Increasing demand for freshwater in Hawaii has placed heavy stress on many of the State's basal aquifer systems. The most heavily stressed of these systems is the Pearl Harbor on Oahu. The Pearl Harbor basal aquifer supplies as much as 277 million gallons per day. Since early in this century, spring discharge has been declining while pumpage has been increasing. Total ground-water discharge has remained steady despite short-term fluctuations. Some wells show general increases in chloride concentration while others remain steady. Chloride concentrations throughout the area show no apparent increase since 1970. Basal water head maps of the Pearl Harbor area clearly reflect the natural discharge points, which are the springs located along the shore near the center of Pearl Harbor. Basal-water hydrographs show a general decline of about 0.09 foot per year. This implies depletion of storage at a rate of about 25 million gallons per day. (USGS).
W80-06362

DEPTH TO THE WATER TABLE IN THE COLORADO SPRINGS--CASTLE ROCK AREA, FRONT RANGE URBAN CORRIDOR, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
D. E. Hillier, and E. C. Hutchinson.
Available from the USGS, Box 25286, Fed. Ctr., Denver, CO 80225, $1.50 in paper copy. Geological Survey Miscellaneous Investigations Series Map I-857-H, 1980. 1 Sheet, 8 Ref.

Descriptors: *Depth, *Water table, *Groundwater mining, *Urban hydrology, *Water resources development, Water table aquifers, Water levels, Water wells, Water level fluctuations, Well data, Maps, Colorado, *Colorado Springs--Castle Rock area(CO).

The depth to the water table can be a relevant factor in decisions regarding urban development. The depth to the water table may affect such activities associated with urban development as the construction of structural and building foundations and basements, and the location of individual waste-disposal systems, landfills and related types of facilities, sanitary sewers, roads and highways, and underground electric and telephone utility lines. Measured depths to the water table during 1976-77 in the unconsolidated alluvial deposits, which contain major water-table aquifers in the area, ranged from 0.8 to 63.7 feet. Depths generally were less than 10 feet in stream valleys and less than 20 feet in terraces except in the southern one-third of the area where depths in terraces were generally more than 20 feet. Annual fluctuations of the water table in the unconsolidated alluvial deposits probably are less than 10 feet although the maximum amount of fluctuation is not known. Generally, both seasonal and annual fluctuations are greater in the terraces than in the stream valleys. Data collected by the U.S. Geological Survey since the middle 1950's indicate that, with few exceptions, the depth to the water table was about the same in 1976-77 as it was in the middle 1950's. (USGS).
W80-06363

WELL YIELDS AND CHEMICAL QUALITY OF WATER FROM WATER-TABLE AQUIFERS IN THE COLORADO SPRINGS--CASTLE ROCK AREA, FRONT RANGE URBAN CORRIDOR, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
D. E. Hillier, and E. C. Hutchinson.
Branch of Distribution, USGS, Box 25286, Fed. Ctr., Denver, CO 80225, $3.00 in paper copy. Geological Survey Miscellaneous Investigations Series Map I-857-I, 1980. 2 Sheets, 12 Ref.

Descriptors: *Water wells, *Water quality, *Chemical analysis, Water table aquifers, *Well data, Pumping, Water yield, Water supply, Urbanization, Freshwater, Saline water, Maps, Colorado, *Colorado Springs--Castle Rock area(CO).

Industrial, irrigation, and public-supply wells completed in unconsolidated alluvial deposits and the Dawson aquifer, the principal water-table aquifers in the area, have measured and reported yields ranging from less than 100 to 1,000 gallons per minute. Most wells yielding more than 500 gallons per minute are located in the Colorado Springs area and are completed in unconsolidated alluvial deposits. The maximum reported yields from the Dawson aquifer are 500 gallons per minute. Most of the principal water-table aquifers yield water containing dissolved solids concentrations less than 500 milligrams per liter. Water containing more

than 500 milligrams per liter of dissolved solids occurs principally in the Colorado Springs area. Water containing less than 500 milligrams per liter of dissolved solids generally is suitable for all uses associated with urban development. The potential uses for urban development decrease as dissolved solids concentrations in the water increase. (USGS).
W80-06364

HOW MUCH IS THE RECHARGE TO THE OGALLALA,
High Plains Underground Water Conservation District No 1, Lubbock, TX.
C. D. McReynolds.
The Cross Section, Vol 25, No 8, p 1-2, August 1979.

Descriptors: *Natural recharge, *Groundwater recharge, *Texas, Data collections, Logging(Recording), Boreholes, Rain gages, Neutron activation analysis, Soil moisture, Irrigation water, Ogallala aquifer(TX).

Since the original study of natural recharge to the Ogallala Aquifer in 1940, agricultural practices have favorably altered the recharge rate prompting the U.S. Geological Survey to undertake a new study. As part of this study, the Texas Department of Water Resources is collecting data from rain gages and 30-foot deep access tubes in both irrigated and non-irrigated soils. A neutron moisture logging instrument is used to determine moisture content in the soil surrounding the access tubes. Accurate determinations of rainfall and irrigation water are necessary to verify and quantify the measurements. The project assumes that moisture passing below 30 feet will ultimately reach the water table. Factors which influence recharge rate include: the amount, duration, and intensity of precipitation; the amount of moisture in the soil when the rain or snowmelt begins, and the temperature, vegetative cover and permeability of materials at the site. (Purdin-NWWA).
W80-06413

EFFECTIVENESS OF FIELD TRIPS IN TEACHING GROUNDWATER CONCEPTS,
Nebraska Univ., Lincoln. Dept. of Geology.
For primary bibliographic entry see Field 9A.
W80-06415

GEOLOGY AND HYDROGEOLOGY OF THE BECHER POINT LINE AND GEOLOGICAL REINTERPRETATION OF ADJACENT BOREHOLE LINES,
A. D. Allen.
Western Australia Geological Survey Annual Report, Vol 1977, p 19-28, 1977. 11 Fig, 5 Tab, 26 Ref.

Descriptors: *Hydrogeology, *Geologic investigations, *Australia, *Boreholes, Cross-section, Stratigraphy, Aquifer systems, Groundwater recharge, Groundwater movement, Freshwater, Brackish water.

The Becher Point Line of nine boreholes, ranging in depth from 71 to 810 m, were drilled to explore the hydrogeology of the Perth Basin in an area between two old section lines about 45 km south of Perth. Comparison with these earlier results has facilitated a stratigraphic reinterpretation. Ground water occurs in a flow system above and below the South Perth shale except near the Darling Range where the shale is absent. The upper system is recharged by precipitation and stream losses and in turn recharges the Leederville Formation and Rockingham Sand. In the lower system, the Cockleshell Gully and Yarragadee Formations are recharged via the Leederville Formation adjacent to the Darling Scarp. Ground water in both systems flows towards the west where it is discharged into the sea. A large volume of low salinity water is available from the Cockleshell Gully Formation and Leederville Formation adjacent to the Darling Scarp. Very large volumes of brackish water are present in the Cockleshell Gully and Yarragadee Formations beneath the plane and also from the Rockingham Sand. (Purdin-NWWA).
W80-06417

HYDROGEOLOGY OF THE ENEABBA BOREHOLE LINE,
D. P. Commander.
Western Australia Geological Survey Annual Report, Vol 1977, p 13-18, 1977. 7 Fig, 2 Tab, 7 Ref.

Descriptors: *Hydrogeology, *On-site investigations, *Australia, *Boreholes, Cross-sections, Stratigraphy, Aquifer systems, Freshwater, Brackish water, Groundwater recharge, Groundwater movement, Groundwater barriers, Thermacline.

Twenty-eight boreholes were drilled to depths of about 800 m in the Perth basin near Eneabba, Australia to provide a stratigraphic and hydrogeological cross section. The drilling encountered sediments ranging in age from Friassic to Lower Cretaceous and forming a synclinal structure with a faulted west limb and a very shallow dipping east limb. The four major aquifers in the area are, in order of importance, the lower Yarragadee Formation, the upper Yarragadee Formation, the Cockleshell Gully Formation, and the Lesueur Sandstone. Fresh water is present in all the formations and extends below 800 m. Recharge to these aquifers is by rainfall on their outcrop areas, and regional ground water flow is northwards. Impermeable Friassic rocks near the coast are a barrier to westward ground water movement. The Otorowiri Siltstone acts as an aquiclude between the upper and lower Yarragadee Formation aquifer and maintains a head difference of 140 m. The geothermal gradient is highest in the west and may be due to the shallowness of crystalline basement, the presence of more thermally insulating beds and an upward direction of ground water flow. (Purdin-NWWA).
W80-06418

GROUND WATER: THE SEISMOLOGIST'S TOOL OF THE FUTURE,
National Water Well Association, Worthington, OH.
For primary bibliographic entry see Field 7B.
W80-06424

DROUGHT AND GROUND DEFORMATION CAMBRIA, SAN LUIS OBISPO COUNTY, CALIFORNIA,
California Div. of Mines and Geology, Los Angeles.
G. B. Cleveland.
California Geology, p 29-35, February 1980. 5 Fig, 6 Tab, 2 Ref.

Descriptors: *Land subsidence, *Water level fluctuations, *Droughts, Water supply, Groundwater, Water table, California.

The drought of 1975-76 caused lowering of ground water levels along the coast of California which resulted in ground deformation in Cambria. The near surface sediments in this area are mostly clays and sandy clays with high moisture contents. A fault divides the area into two hydrologic units. Southwest of the fault the sediments have only a small fraction of the ground water storage capacity of the main part of the basin. However, three water supply wells were drilled in this area. During the drought year of 1976 water level fell 53 feet before a water injection and conservation program was implemented. As the water level fell, sand and clay particles compacted, the deposits became consolidated and the ground surface subsided. Close correlation was observed between time and amount of water level lowering and time and degree of ground subsidence. Subsidence occurred when ground water level was lowered 30 to 50 feet. After subsidence started, leaks developed in the water and sewer lines causing local flooding of shallow subsurface zones. This helped maintain water levels and ground stability to some extent. (Purdin-NWWA).
W80-06426

FAULT ZONE CONTROLLED CHARGING OF A LIQUID-DOMINATED GEOTHERMAL RESERVOIR,
Colorado Univ. at Boulder. Dept. of Mechanical Engineering.
K. P. Goyal, and D. R. Kassoy.
Journal of Geophysical Research, Vol 85, No B4, p 1867-1875, April 10, 1980. 11 Fig, 1 Tab, 34 Ref.

Descriptors: *Geothermal studies, *Reservoirs, Faults(Geologic), Mathematical models, Numerical analysis, Boundary layers, Pressure, Velocity, Temperature, Thermocline, Flow, Thermal water.

This paper describes a mathematical model for a geothermal reservoir charged by heated water from a vertical fault zone. The model assumes a liquid-dominated geothermal system of finite vertical extent with an impermeable upper boundary. Saturated porous media equations are used to describe this model. The solution techniques involve the combination of perturbation methods, boundary layer theory, and numerical methods. Results are presented for the pressures, velocities, temperatures, and temperature gradients in the system. In addition, a study is made of the effect of various parameters such as mass flow rate, Rayleigh number, and fault width on these solutions at different locations in the fault and in the aquifer. This analysis can be applied to geothermal systems where the thickness of the impermeable reservoir cap is quite small compared to reservoir depth. Surface heat flux distributions, downhole temperature distributions, and predicted formation pressure-depth variations can be used to obtain both indirect data and model verification. (Purdin-NWWA).
W80-06427

2G. Water In Soils

TOPOGRAPHY AND HILLSLOPE SOIL WATER RELATIONSHIPS IN A CATCHMENT OF LOW RELIEF,
Bristol Univ. (England). Dept. of Geography.
M. G. Anderson, and P. E. Kneale.
Journal of Hydrology, Vol 47, No 1/2, p 115-128, May 1980. 11 Fig, 1 Tab, 10 Ref.

Descriptors: *Soil water, *Topography, *Watersheds(Basins), *On-site data collections, *Base flow, Surface-groundwater relationships, Water table, Hydrographs, Rainfall-runoff relationships, Tensiometers, Slopes, Hillslopes.

Soil water potentials were mapped on a 6 degree hillslope during summer and winter conditions in a 0.8-sq km catchment. It was shown that the dynamic hillslope contributing area was maintained at the slope base for long periods after precipitation ceased. Additionally, the focus of the hillslope soil water convergence was not always at the hollow base but was seen to migrate in the downstream direction and to accord with a hillslope spur. Microtopographic features were shown thereby to influence, but not to be the sole dominant control upon, the spatial disposition of hillslope contributing areas in low angled topography. (Visocky-ISWS)
W80-06204

A DESCRIPTIVE MODEL OF THE RELATIONSHIP BETWEEN RAINFALL AND SOIL WATER TABLE,
Forest Research Station, Farnham (England).
K. Rennolls, R. Carnell, and V. Tee.
Journal of Hydrology, Vol 47, No 1/2, p 103-114, May 1980. 5 Fig, 15 Ref.

Descriptors: *Statistical models, *Water table, *Soil water, *Rainfall, *Correlation analysis, *Water levels, Observation wells, Soil horizons, Computer programs, Boreholes, Mathematical models, Equations, Drainage, Regression analysis.

A first-order autoregressive model was used to describe the response of the water level in a borehole to a series of rainfall events. A computer program was written to determine the maximum likelihood estimates of the paramters of this model, and the trajectories produced were then compared with those from a straightforward application of least squares by applying them to a simulated time

series. The model was then applied to data obtained from a drainage experiment. The descriptive characteristion of the dynamic behavior of the borehole levels by the three parameters of the authors' model is an improvement over characterization by static methods such as means and variances. Furthermore, the model can be used to predict borehole levels in response to given rainfall events. (Visocky-ISWS)
W80-06205

ESTIMATING RECHARGE TO THE GROUNDWATER RESERVOIR IN SUFFOLK COUNTY, NEW YORK BY MEASURING SOIL WATER FLOW,
Cornell Univ., Ithaca, NY. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2F.
W80-06226

MODIFICATION OF TEMPE PRESSURE CELL FOR THE MEASUREMENT OF SATURATED HYDRAULIC CONDUCTIVITIES,
Department of Agriculture, Lethbridge (Alberta).
For primary bibliographic entry see Field 7B.
W80-06252

EFFECT OF THE SPARTINA ALTERNIFLORA ROOT-RHIZOME SYSTEM ON SALT MARSH SOIL DENITRIFYING BACTERIA,
Georgia Univ., Athens. Dept of Microbiology.
For primary bibliographic entry see Field 2I.
W80-06258

CURVE-NUMBER PROCEDURE AS INFILTRATION METHOD,
Science and Education Administration, Columbia, MD. North Central Watershed Research Center.
A. T. Hjelmfelt, Jr.
Journal of the Hydraulics Division, Amerian Society of Civil Engineers, Vol 106, No HY6, Technical Note, p 1107-1111, June 1981. 2 Fig, 8 Ref, 1 Append.

Descriptors: *Rainfall, *Infiltration, *Analytical techniques, *Hydrology, *Infiltration rates, Precipitation excess, Runoff, Mathematical models, Analysis, Theoretical analysis, Soil moisture, Rainfall-runoff relationships.

The Soil Conservation Service (SCS) curve-number procedure is commonly used to determine rainfall excess. The advantage of this method is that the parameters in the relation are the soil type, land use, and precipitation, each of which is relatively easy to estimate. The procedure for analysis of intermittent rainfall and for portions of storms where rainfall intensity is less than infiltration capacity is not well defined. In addition, the SCS method predicts that the infiltration rate will approach zero during storms of long duration instead of a constant terminal infiltration rate. In order to investigate the curve-number procedure, the basic equations were differentiated in this paper to yield an infiltration rate relation. Algebraic manipulation of this differential form showed that the curve-number procedure is a special case of the Holtan infiltration function. (Humphreys-ISWS)
W80-06301

A DIGITAL MODEL APPLIED TO GROUND WATER RECHARGE AND MANAGEMENT,
Colorado Dept. of Natural Resources, Denver. Div. of Water Resources, Planning and Investigations.
C. Y. Lee, A. R. Qazi, and J. A. Danielson.
Water Resources Bulletin, Vol 16, No 3, p 514-521, June 1980. 4 Fig, 2 Tab, 11 Ref.

Descriptors: *Computer models, *Groundwater recharge, *Colorado, *Water management(Applied), *Prior appropriation, *Surface-groundwater relationships, Pumping, Economic feasibility, Surface waters, Numerical analysis, Water table, Hydraulic conductivity, Aquifer management, Finite-difference models.

Under Colorado's appropriative water right system, withdrawals by junior groundwater rights must be curtailed to protect senior surface water appropriators sharing the same river system unless the groundwater users replace the amount of their injury to the river under an approved plan for augmentation. Compensation of such injury with surface water may not only be expensive but unreliable in dry years. As an alternative, the curtailment of pumping may be obviated by recharging unused surface water into the aquifer when available and withdrawing it when needed. In order to manage such an operation, a practical tool is required to determine accurately that portion of the recharge water that does not return to the river before pumping for irrigation. A digital model was used for this purpose in a demonstration recharge project located in the South Platte River basin in northeastern Colorado. This paper summarized the experiences gained from this project, the results of the digital model, the economic value of recharge, and the feasibility of the operation. It was determined through the use of the digital model that, with the given conditions in the area, 77% of the recharged water remained available for pumping. Economic analyses showed that water could be recharged inexpensively averaging about two dollars per acre foot. (Visocky-ISWS).
W80-06305

PERCOLATE WATER AND BROMIDE MOVEMENT IN THE ROOT ZONE OF EFFLUENT IRRIGATION SITES,
Oklahoma State Univ., Stillwater. Dept. of Forestry.
For primary bibliographic entry see Field 5B.
W80-06309

PRELIMINARY EVALUATION OF AN ALTERNATE ELECTRODE ARRAY FOR USE IN SHALLOW SUBSURFACE ELECTRICAL RESISTIVITY STUDIES,
Auburn Univ., Al. Dept. of Geology.
T. J. Carrington, and D. A. Watson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80 220163, Price codes: A03 in paper copy, A01 in microfiche. Completion Report, July, 1980. 35 p, 9 Fig, 2 Tab, 10 Ref. OWRT A-046-ALA(1), 14-34-0001-5001.

Descriptors: *Electrodes, *Resistivity, Evaluation, Performance, Soil moisture, *Soil moisture meters, Instrumentation, Laboratory tests, On-site investigations, Reliability, Soil physical properties, Soil profiles, Testing, *Subsurface layer boundaries, Depth.

Laboratory and field investigations were conducted to evaluate the efficiencies of Wenner, Schlumberger, and Modified Wenner electrodes in predicting subsurface conditions. The electrodes were evaluated with regard to reliability of the data under most conditions examined, speed of field use, and straight-line distance required for a given test. Laboratory experiments were conducted using a tabletop tray which could simulate different subsurface conditions. The Modified Wenner and Schlumberger arrays were faster than the Wenner in predicting depth to subsurface layer boundries, although all three arrays were accurate. In a homogeneous subsurface material only the Modified Wenner gave a cumulative graph that was a straight line, but the Wenner and Schlumberger arrays proved more practical in lateral profiling. In short, shallow lateral profiles, the Modified Wenner array was the instrument of choice. In field tests the Modified Wenner was also found to be superior when both apparent resistivity and cumulative graphs were constructed. The Modified Wenner array has several advantages in terms of energy, time, and space over the other arrays even though the reasons for these advantages are not fully understood. (Sidney-IPA).
W80-06324

A SIMULATION MODEL FOR PREDICTING INFILTRATION INTO CRACKED CLAY SOIL,
Agricultural Univ., Wageningen (Netherlands). Soil Tillage Lab.
W. B. Hoogmoed, and J. Bouma.
Soil Science Society of America Journal, Vol 44, No 3, p 458-461, May-June 1980. 5 Fig, 1 Tab, 11 Ref.

Descriptors: *Infiltration, *Model studies, *Unsaturated flow, *Clays, Hydraulic conductivity, Flow characteristics, Laboratory tests, Methodology, Soil water movement, Seepage, Mathematical models, Analytical techniques, Cracks, Flow, Diffusivity, Cracked clay soils.

Infiltration into dry cracked clay soil was simulated by combining two existing physical simulation models for vertical and horizontal infiltration, using boundary conditions for horizontal infiltration that were defined by morphological data. Vertical flow into the cracks occurred when the application rate exceeded the calculated vertical infiltration rate of peds between cracks. Calculated horizontal infiltration from the cracks into adjacent dry peds was limited because it had to occur from a few small vertical bands along which the water moved. The contact area (S) of all bands had been determined in situ in 0.5 sq m plots per 10-cm depth interval using morphological staining techniques. S was a function of the applied flow regime. 'Short-circuiting', which was defined as preferential movement of free water along large pores through unsaturated soil, was predicted well by the model. Short-circuiting increased when the initial moisture content of the soil was higher. (Humphreys-ISWS).
W80-06377

ELECTROMAGNETIC DETERMINATION OF SOIL WATER CONTENT: MEASUREMENTS IN COAXIAL TRANSMISSION LINES,
Agriculture Canada, Ottawa (Ontario). Land Resource Research Inst.
G. C. Topp, J. L. Davis, and A. P. Annan.
Water Resources Research, Vol 16, No 3, p 574-582, June 1980. 9 Fig, 4 Tab, 24 Ref.

Descriptors: *Soil water, *Moisture content, *Laboratory tests, *Electromagnetic waves, Soils, Soil properties, Electrical properties, Soil types, Equipment, Laboratory equipment, Transmission lines, Measurement, Data processing, Soil science, Dielectric constant.

The dependence of the dielectric constant, at frequencies between 1 MHz and 1 GHz, on the volumetric water content was determined empirically in the laboratory. The effect of varying the texture, bulk density, temperature, and soluble salt content on this relationship was also determined. Time-domain reflectometry (TDR) was used to measure the dielectric constant of a wide range of granular specimens placed in a coaxial transmission line. The water or salt solution was cycled continuously to or from the specimen, with minimal disturbance, through porous disks placed along the sides of the coaxial tube. Four mineral soils with a range of texture from sandy loam to clay were tested. An empirical relationship between the apparent dielectric constant K sub a and the volumetric water content theta sub v which is independent of soil type, soil density, soil temperature, and soluble salt content, can be used to determine theta sub v from air dry to water saturated, with an error of estimate of 0.013. Precision of theta sub v to within +0.01 from K sub a can be obtained with a calibration for the particular granular material of interest. An organic soil, vermiculite, and two sizes of glass beads were also tested successfully. The empirical relationship determined in this experiment agrees very well with other experimenters' results, which use a wide range of electrical techniques over the frequency range of 20 MHz and 1 GHz and widely varying soil types. The results of applying the TDR technique on parallel transmission lines in the field to measure theta sub v versus depth were encouraging. (Sims-ISWS).
W80-06395

DETERMINATION OF SOIL WATER CONTENT FROM TERRESTRIAL GAMMA RADIATION MEASUREMENTS,
National Hydrology Research Inst., Ottawa (Ontario).
H. S. Loijens.
Water Resources Research, Vol 16, No 3, p 565-573, June 1980. 6 Fig, 7 Tab, 16 Ref, 1 Append.

Descriptors: *Soil water, *Moisture content, *Gamma rays, *Moisture meters, *Model studies, Mathematical models, Measurement, On-site data collections, Instrumentation, Theoretical analysis, Equations, Analytical techniques, Soils, Profiles, Soil profiles, Soil science.

Natural gamma radiation emitted by the soil and measured at the surface with a gamma ray spectrometer is a function of the radioactive activity of the soil and the linear attenuation coefficient. The dependence of the linear attenuation coefficient on soil water content was explored for selected soil water profiles by numerical integration. These soil water profiles were generalized distributions based on gravimetric measurements over a sandy soil at the Central Experimental Farm in Ottawa. A comprehensive analysis of the measurements showed that inhomogeneous water distribution accounted for a 1.8% error in the count rate compared to a 2.6% error associated with random count rate fluctuation and instrument error. The depth of the soil layer contributing to natural gamma radiation at the surface depends also on the water content; 90% of the total radiation is contributed by a dry soil of depth 0.18 m, compared to 0.14 m for a soil with a fractional water content of 0.2. The total expected error in the measurement over the range of soil water encountered (0.03-0.24) was shown to be 0.033 for the 0.10-m layer and 0.025 for the 0.25-m layer. (Sims-ISWS).
W80-06396

A DERIVATION OF THE MACROSCOPIC SOLUTE TRANSPORT EQUATION FOR HOMOGENEOUS, SATURATED, POROUS MEDIA,
California Univ., Riverside. Dept. of Physics.
S-Y. Chu, and G. Sposito.
Water Resources Research, Vol 16, No 3, p 542-546, June 1980. 1 Tab, 26 Ref. NSF ENG76-09210-01.

Descriptors: *Solutes, *Soil water movement, *Porous media, *Model studies, Mathematical models, Theoretical analysis, Soils, Pores, Soil properties, Soil water, Equations, Analytical techniques, *Solute transport.

The macroscopic transport equation for a conservative solute in a homogeneous, water-saturated porous medium was derived on the basis of a rigorous cumulant expansion applied to the equation of mass balance. The essential physical concept underlying the derivation was that of a local volume-averaged solute velocity which fluctuates on a time scale that was orders of magnitude smaller than its autocorrelation time scale, which, in turn, was much smaller than the time scale of interest in a typical solute transport experiment. This clear separation of time scales was illustrated with representative data on solute transport in homogeneous, water-saturated soils and is employed to justify the truncation of an exact cumulant expansion of the divergence of the volume-averaged solute mass flux density. With the cumulant expansion terminated at first order in the ratio of the solute velocity autocorrelation time to the macroscopic solute transport time interval, an expression for the macroscopic solute mass flux density was produced that was the same as Fick's Law extended to porous media. (Sims-ISWS).
W80-06397

APPLICATION OF THE GREEN-AMPT MODEL TO INFILTRATION UNDER TIME-DEPENDENT SURFACE WATER DEPTHS,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W80-06399

2H. Lakes

RANGE ANALYSIS FOR RESERVOIR STORAGE WITH INDEPENDENT INFLOWS,
Asian Inst. of Tech., Bangkok (Thailand).
For primary bibliographic entry see Field 2E.
W80-06208

INVESTIGATION OF LAKE ONTARIO WATER QUALITY NEAR PORT GRANBY RADIOACTIVE WASTE MANAGEMENT SITE,
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 5B.
W80-06214

METALLIC CONTENTS IN WATER AND SEDIMENS OF LAKE NAINI TAL, INDIA,
Kumaun Univ., Naini Tal (India). MAB/DST Lakes Project.
For primary bibliographic entry see Field 5A.
W80-06216

STEADY-STATE ESTIMATION OF COOLING POND PERFORMANCE,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5F.
W80-06300

STREAMFLOW AND RESERVOIR-CONTENT RECORDS IN TEXAS, COMPILATION REPORT, JANUARY 1889 THROUGH DECEMBER 1975,
Texas Dept. of Water Resources, Austin.
For primary bibliographic entry see Field 7C.
W80-06375

SEDIMENTATION OF DETRITAL PARTICULATE MATTER IN LAKES: INFLUENCE OF CURRENTS PRODUCED BY INFLOWING RIVERS,
Bern Univ. (Switzerland). Geologisches Inst.
R. F. Wright, and P. Nydegger.
Water Resources Research, Vol 16, No 3, p 597-601, June 1980. 3 Fig, 14 Ref.

Descriptors: *Lake sediments, *Sedimentation, *Lakes, Rivers, Sediments, Fine aggregates, Limnology, Hydrology, Water circulation, *Currents(Water), *Inflow, Mixing, *Lake Brienz (Switzerland), *Lake Biel(Switzerland), *Detrital particulate matter, *Switzerland, Lake circulation.

Inflowing rivers can provide a major driving force for water circulation in lakes in which water turnover time is short, that is, less than a few years. Such inflow-induced currents strongly influence the dispersion and sedimentation of allochthonous particulate matter, especially fine-grained particles that can remain in suspension in lake water for days or weeks. The authors presented data to illustrate the importance of inflow-induced circulation on sedimentation patterns in Lake Brienz and Lake Biel, two large lakes in northwestern Switzerland, and suggested that such currents should not be disregarded in sedimentological studies of similar lakes elsewhere. (Lee-ISWS).
W80-06390

METALIMNETIC OXYGEN MINIMA IN LAKE ONTARIO, 1972,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
J. D. Boyd.
Journal of Great Lakes Research, Vol 6, No 2, p 95-100, 1980. 4 Fig, 1 Tab, 24 Ref.

Descriptors: *Dissolved oxygen, *Lake Ontario, *Oxygen requirements, *Thermocline, Dissolved oxygen analyzers, Stratification, Lakes, Phytoplankton, Zooplankton, Epilimnion, Salinity, Aquatic bacteria.

Oxygen profiles collected in Lake Ontario in 1972 showed a distinct lake-wide oxygen minimum in the thermocline region during thermal stratification; data from previous years also indicated this phenomenon. Four factors were considered in processing the oxygen data: (1) salinity and temperature corrections; (2) calibration; (3) flow sensitivity; and (4) instrument-response time. The study found that the motions of the oxygen minima tended to follow the motion of the thermocline. The average depth of minimum percent saturation lay below the average thermocline depth, while the average depth of minimum dissolved oxygen lay at or slightly above the thermocline. Both values tended to decrease throughout the summer until September when they began to rise again. A definite correlation was found between the average strength of stratification and average magnitudes of dissolved oxygen-percent saturation minima. The main factors contribution to a metalimnetic oxygen minimum were: (1) lake productivity (phytoplankton and zooplankton respiration and bacterial decomposition; (2) kinematic consequences of the temperature gradient (decreased seston settling velocities, suppressed vertical advection, and turbulent diffusion); (3) water transparency (location of the thermocline below the euphotic zone); and (4) horizontal advection of oxygen-depleted water. A determination of the relative importance of various mechanisms at different times and places awaits research. (DeCoquereaumont-IPA).
W80-06438

SIMULATION OF RECENT AND PROJECTED TOTAL PHOSPHORUS TRENDS IN LAKE ONTARIO,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 5B.
W80-06439

ORGANOCHLORINE INSECTICIDES AND PCB IN THE SURFICIAL SEDIMENTS OF LAKE SUPERIOR (1973),
Ontario Ministry of Agriculture and Food, Guelph. Pesticide Residue Lab.
For primary bibliographic entry see Field 5A.
W80-06440

GRAIN SIZE AND MINERALOGY OF SEDIMENT CORES FROM WESTERN LAKE HURON,
Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
E. J. Graham, and D. K. Rea.
Journal of Great Lakes Research, Vol 6, No 2, p 129-140, 1980. 5 Fig, 2 Tab, 21 Ref.

Descriptors: *Mineralogy, *Lake Huron, *Sediments, *Particle size, Sampling, Sedimentology, Glaciers, Great Lakes, Clays, Carbonates, Silts, Mud, Lakes, Erosion, Physical properties, Radioactive dating, Carbon radioisotopes, Stratigraphy, Lake sediments, Water levels, Turbulence, Evaluation.

The results of a study of 12 core samples recovered from the Alpena and Manitoulin Basins of western Lake Huron are reported. Grain size and mineralogical changes combined with radiocarbon dating of surficial and basal sediments were used to establish the sedimentary history of that part of Lake Huron. The sedimentation is directly related to glaciation in the Great Lakes region and the base is of reddish glaciolacustrine clays (or 10 phi grain size) overlain by a veneer of till, reddish-grey glaciolacustrine clays, and finally grey post-glacial muds. These muds which appeared approximately 11,000 years ago are composed of course and very fine silt in their upper portions. About thirty percent of the older sediments are composed of detrital carbonates and the abundance is reduced in more recent sediments. No detrital carbonates accumulated in the Alpena and southwestern Manitoulin Basins since about 1,500 years ago probably due to a change in the supply rate. Lakeshore erosion could have been reduced and more bioturbation occurred as lake levels receeded from the Nipissing high stand and produced little carbonate sedimentation. High water levels prior to and during Nipissing time would have produced erosion of nearshore tills and of exposed lacustrine sediments. (Sidney-IPA).
W80-06442

LIMNOLOGICAL SAMPLING INTENSITY IN LAKE ST. CLAIR IN RELATION TO DISTRIBUTION OF WATER MASSES,
Ontario Ministry of Natural Resources, Wheatley.

Fisheries Research Station.
For primary bibliographic entry see Field 5A.
W80-06443

RECENT CHANGES IN THE NEAR-SHORE PHYTOPLANKTON OF LAKE ERIE'S WESTERN BASIN AT KINGSVILLE, ONTARIO,
Ontario Ministry of the Environment, Rexdale. Limnology and Toxicity Section.
K. H. Nicholls, D. W. Standen, and G. J. Hopkins.
Journal of Great Lakes Research, Vol 6, No 2, p 146-153, 1980. 9 Fig, 1 Tab, 29 Ref.

Descriptors: *Phytoplankton, *Lake Erie, *Water quality, *Evaluation, *Forecasting, Water analysis, Aquatic microbiology, Sampling, Laboratory tests, Density, Physical properties, Chemical properties, Phosphorus compounds, Algae, Seasonal, Water levels, Ecology, Eutrophication, Average, Silica, Diatoms.

The results of recent weekly analyses of 'raw' water samples collected at the Union water treatment plant, Kingsville, Ontario, during the period of 1976 through 1978 are reported. The long-term trends in phytoplankton density and composition were compared with physical-chemical factors in the western basin of Lake Erie. Since phosphorus control was begun in 1971, there has been a constant decline in the P loading from the Detroit River to western Lake Erie from a high of 63 microgram P per liter in 1967-70 to an average of 30-35 microgram P per liter during 1977-78. The average annual net phytoplankton (green and blue-green algaes) density also decreased during that period, but increased significantly in the summer of 1978 due to a massive increase in Fragilaria crotonensis. The increase in Fragilaria crotonensis may have resulted from the increased availability of silica (because of low diatom growth during winter and spring) and the observed drop in lake level which influenced turbulent mixing. Annual average diatom density was negatively correlated with the lake levels over the 12-year period. Further studies of the ecology of the western basin, especially the Fragilaria population, is necessary to predict changes in the total phytoplankton densities. (Sidney-IPA).
W80-06444

PREDATION BY MYSIS RELICTA ON PONTOPOREIA HOYI: A FOOD CHAIN LINK OF POTENTIAL IMPORTANCE IN THE GREAT LAKES,
Argonne National Lab., IL. Ecological Sciences Section.
J. I. Parker.
Journal of Great Lakes Research, Vol 6, No 2, p 164-166, 1980. 12 Ref.

Descriptors: *Predation, *Food web, *Crustaceans, *Great Lakes, Sediments, Bottom sediments, Benthic fauna, Aquatic microorganisms, Aquatic plants, Lake Michigan, Lake Erie, Ecosystems, Laboratory studies, Sampling, Evaluation, Stress, Model studies, Detritus, Plankton, Food chains, Amphipoda, Biological communities.

The predation of the opossum shrimp Mysis relicta, an omnivorous planktivore, on the burrowing amphipod Pontoporeia hoyi, a benthic detritivore was observed for the first time in sediment samples from Lakes Michigan and Erie and reported in this note. Both organisms are abundant in the Great Lakes and are important as food for immature salmonids, coregonids, alewife, and smelt. Sediment core samples with about 10 cm of overlying water were collected with minimal disturbance to the sediment and maintained in the laboratory in the dark at 4 degrees C to simulate the natural environment of the benthic microorganisms and fauna. The predator/prey relationship was observed for an 8 to 10 month period after which time, the mysids had completely depleted the pontoporeia population and died. Predation was observed early in the experiments when planktonic food was still available and this behavior does not totally reflect a stress response to enclosure in the microcosms and/or lack of food. Mysis can utilize both the plankton carbon pool and the benthic/detrital carbon pool and this relationship may represent an important link in the food web of the Great Lakes. (Sidney-IPA).
W80-06446

2I. Water In Plants

WATER WEED USES,
Rothamsted Experimental Station, Harpenden (England). Biochemistry Dept.
N. W. Pirie.
Water Spectrum Vol 12, No 3, p 43-49, Summer 1980. 8 Fig, 1 Tab.

Descriptors: *Aquatic weeds, *Forages, *Fertilizers, *Aquatic weed control, Vegetation effects, Nitrogen compounds, Phosphorous compounds, Forage palatability, Food abundances, Nutrients, Food habits, Pesticides, Drying, Silage, Cost analysis, Proteins, Feeds, Water pollution.

Water weeds which have long been regarded as nuisances, unaesthetic, or health hazards may be an excellent source of animal food and fertilizer. A hectare of weeds may contain 1 ton of nitrogen, 1.3 ton of potassium, and 0.2 ton of phosphorous. Weed control by herbicides may contaminate the water, so the collection of weeds for forage is an attractive solution. Many of the weeds resemble medium grades of forage in composition and many animals have been voluntarily eating water weeds in many parts of the world. Silage made from weeds is often acceptable than fresh weeds and a palatable silage can be made by adding acid (as in AIV silage), or molasses. Moisture removal from the weeds may be costly in terms of energy, but the economics have not been studied. About 75% of the water can be removed by air drying in a dry climate. Water weeds could be harvested for methane fermentation, leaf protein, and juice extraction. (Sidney-IPA)
W80-06234

ECOSYSTEM DYNAMICS AND A PHOSPHORUS BUDGET OF AN ALLUVIAL CYPRESS SWAMP IN SOUTHERN ILLINOIS,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
For primary bibliographic entry see Field 2A.
W80-06254

EFFECT OF THE SPARTINA ALTERNIFLORA ROOT-RHIZOME SYSTEM ON SALT MARSH SOIL DENITRIFYING BACTERIA,
Georgia Univ., Athens. Dept of Microbiology.
B. F. Sherr, and W. J. Payne.
Applied and Environmental Microbiology, Vol 35, No 4, p 724-729, April, 1978. 2 Fig, 2 Tab, 17 Ref. OWRT-A-057-GA(3).

Descriptors: *Denitrification, *Soil bacteria, *Marsh plants, *Salt marshes, Effects, Rhizosphore, Wetlands, Muck soils, Grasses, Marshes, Spartina alterniflora marsh.

Nitrous oxide (N2O) reductase activity was used as an index of the denitrification potential in salt marsh soils. In a short Spartina alterniflora marsh, the seasonal distribution of N20 reductase activity indicated a causal relationship between S. alterniflora root-rhizome production and the denitrification potential of the soil system. The relationship was not discerned in samples from a tall S. alterniflora marsh. To further examine the in situ plant-denitrifier interaction in the short S. alterniflora marsh, plots with and without living S. alterniflora were established and analzed for N20 reductase activity 5 and 18 months later. In the plots without living Spartina there was a significant reduction in the soil denitrification potential after 18 months, indicating that in the SS marsh the denitrifiers are tightly coupled to the seasonal production of below-ground Spartina macroorganic matter. In plots with intact Spartina, the soil denitrification potential was not altered by NH4NO3 or glucose enrichment. However, in plots without living Spartina, there were significat changes in soil N2O reductase activity, thus indicating that the plants can serve as a 'buffer' against this form of pluse perturbation. (Steiner-Mass)
W80-06258

2J. Erosion and Sedimentation

THE MEASUREMENT OF SUSPENDED SEDIMENT TRANSPORT IN NATURAL STREAMS USING AUTOMATIC RADIOISOTOPE GAUGES,
Bari Univ., (Italy). Inst. di Geologia Applicata e Geotecnica.
G. S. Tazioli.
Journal of Hydrology, Vol 47, No 1/2, p 173-185, May 1980. 11 Fig, 12 Ref.

Descriptors: *Suspended solids, *Sediments, *Gages, Radioisotopes, Instrumentation, Equipment, On-site investigations, Measurement, Automation, Turbidity, Sediment transport, Floods, Streams, Streamflow, Discharge(Water), Erosion, Sedimentology, *Italy.

Two nuclear gages for measuring suspended-sediment concentration installed in hydrographic fasins in southern Italy were illustrated. These gages were equipped with a source of 241Am(100 mCi), and 137Cs(150 mCi), and were able to resist large sized sediment transport. The main characteristics of the gages were those of being automatic, which is useful for torrent regimes, and of giving a linear response also at high sediment concentrations. One-year turbiometric recordings with the 241Am gage were presented. (Sims-ISWS)
W80-06202

METAL CONCENTRATIONS IN MARINE SEDIMENTS FROM LEBANON,
ARABCONSULT, Beirut (Lebanon).
For primary bibliographic entry see Field 5A.
W80-06213

CHANNEL EROSION AND SEDIMENT TRANSPORT IN PHEASANT BRANCH BASIN NEAR MIDDLETON, WISCONSIN--A PRELIMINARY REPORT,
Geological Survey, Madison, WI. Water Resources Div.
R. S. Grant, and G. Goddard.
Available from OFSS, Box 25425, Fed. Ctr., Denver, CO 80225. Paper copy $3.50, Microfiche $5.50. Geological Survey open-file report 80-161 (WRI), February 1980. 19 p, 11 Fig, 3 Tab, 12 Ref.

Descriptors: *Channel erosion, *Sediment transport, *Streamflow, *Flow characteristics, *Wisconsin, Channel morphology, Land use, Effects, Erosion control, Control structures, Dredging, Boating, Evaluation, *Pheasant Branch basin(WI), *Lake Mendota(WI), *Middleton(WI).

The purpose of this 5-year study is to (1) evaluate the sediment transport, streamflow characteristics, and stream-channel morphology, (2) relate the above to land-use practices; and (3) evaluate the effect that changes in land-use practices will have on Pheasant Branch basin near Middleton, Wis. This report presents findings of sediment transport, streamflow characteristics, and stream-channel morphology from the first year of the study and documents historical erosion. The study is being conducted by the U.S. Geological Survey in cooperation with the city of Middleton and the Wisconsin Geological and Natural History Survey. Pheasant Branch, a tributary to Lake Mendota, drains 23.1 square miles of glacial drift. Channel erosion is severe within Middleton, requiring extensive use of erosion-control structures. Occasionally, channel dredging near the mouth and into Lake Mendota is required for boating. Comparison of stream-channel surveys of 1971 and 1977 shows the lowest part of the channel lowered 3 to 4 feet at some sites in the urban reach from U.S. Highway 12 downstream to Century Avenue. Downstream from Century Avenue, channel width increased from about 35 to 48 feet and channel cross-section area increased about 86 percent. A survey of Pheasant Branch in 1971 provided data for quantification of stream-channel changes since that time. Six erosion-control structures previously installed appear to have had some benefit in controlling head cutting in the channel. (USGS).

W80-06241

COMPARISON OF BED FORM VARIANCE SPECTRA WITHIN A MEANDER BEND DURING FLOOD AND AVERAGE DISCHARGE,
South Carolina Univ., Columbia. Dept. of Geology.
R. A. Levey, B. Kjerfve, and R. T. Getzen.
Journal of Sedimentary Petrology, Vol 50, No 1, p 149-155, March 1980. 5 Fig, 20 Ref.

Descriptors: *Meanders, *River beds, *Alluvium, *Floods, *Time series analysis, Statistical methods, Flood discharge, Profiles, Sediments, Channel morphology, *Congaree River(SC), *Bed forms, Variance spectra.

Time series analysis of streambed elevation in a meander bend along the Congaree River was used to determine the changes in bed form population succeeding a 16-year flood event. Bed forms observed during the flood event had a significantly greater total height variance than bed forms observed at the same location one week later. Variance spectra were computed for a 595-meter longitudinal profile. The data indicate that (a) the bed form variance for the flood record is significantly greater for all wavelengths from 5 to 30 meters; (b) no well-demarcated bed form classes were present during the survey times, pointing to the possible existence of a continuum of bed form sizes rather than well-defined classes; and (c) bed forms produced by the flood discharge were rapidly altered as the stage returned toward average level. (Kosco-USGS).
W80-06245

EFFECTIVE AND BANKFULL DISCHARGES OF STREAMS IN THE YAMPA RIVER BASIN, COLORADO AND WYOMING,
Geological Survey, Lakewood, CO. Water Resources Div.
E. D. Andrews.
Journal of Hydrology, Vol 46, p 311-330, 1980. 12 Fig, 1 Tab, 15 Ref.

Descriptors: *Discharge(water), *Streamflow, *Sediment transport, *Colorado, *Wyoming, River basins, Flow rates, Flow duration, Bed load, Sedimentation rates, Stage-discharge relations, Floods, Geomorphology, Hydrographs, Curves, *Yampa River basin, *Bankfull discharge.

The effective discharge is defined as the increment of discharge that transports the largest fraction of the annual sediment load over a period of years. Increments of the average annual total sediment load transported by various discharges were calculated by the flow-duration sediment-transport-curve method for 15 gaging stations in the Yampa River basin of Colorado and Wyoming. A total sediment-transport curve was constructed for each gaging station by adding measured instantaneous suspended-sediment discharges to bedload-sediment discharges computed by the Meyer-Peter and Mueller relation. The streamflow durations were compiled from the respective gaging-station records. The quantity of sediment transported by discharges having various frequencies may be computed by combining these two relations. The 15 gaging stations had diverse hydraulic and sediment characteristics. Contributing drainage area ranged from 51.8 to 9,960 sq km, and mean-annual discharge ranged from 0.040 to 43.9 cu m/s. The median diameter of bed material ranged from 0.4 to 86 mm. Mean-annual sediment load from the drainage basins studied ranged from 500 to 1.3 million t/yr. The effective discharges were equaled or exceeded on the average of between 1.5 and 11 d/yr, and the recurrence interval ranged from 1.18 to 3.26 years on the annual flood series. To compare the effective discharge with the bankfull discharge, cross sections were surveyed in a self-formed reach of the channel in the vicinity of each gaging station. The bankfull discharge was defined as the discharge which filled the channel to the level of the flood plain. At all gaging stations, the effective discharge and the bankfull discharge were nearly equal. Thus, the stream channels appear to be adjusted to their effective discharge. (Kosco-USGS).

W80-06246

OPTIMIZED RUNOFF CURVE NUMBERS FOR SUGARCANE AND PINEAPPLE FIELDS IN HAWAII,
Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 2A.
W80-06289

FLOWSLIDES IN MUDS ON EXTREMELY LOW ANGLE TIDAL FLATS, NORTHEASTERN SOUTH AMERICA,
Louisiana State Univ., Baton Rouge. Coastal Studies Inst.
For primary bibliographic entry see Field 2L.
W80-06290

EFFECTS OF DECREASING WATER DEPTHS ON THE SEDIMENTATION RATE OF ILLINOIS RIVER BOTTOMLAND LAKES,
Illinois Natural History Survey, Havana. River Research Lab.
D. W. Steffeck, F. L. Paveglio, Jr, F. C. Bellrose, and R. E. Sparks.
Water Resources Bulletin, Vol 16, No 3, p 553-555, June 1980. 2 Fig, 7 Ref. Army DACW23-76-C-0066.

Descriptors: *Sedimentation, *Sedimentation rates, *Lakes, *Depth, Sampling, On-site investigations, Data processing, Regression analysis, Sediment transport, Rivers, Erosion, Sediments, Lake sediments, Sedimentology, *Illinois River, *Peoria Lake(IL), Lake Meredosia(IL).

The annual sedimentation rate of lakes and reservoirs is usually not evaluated for changes in depth relative to time. By using a linear regression with depth as the independent variable and annual rate of fill as the dependent variable, the effect of changing depths is negated. According to both profile and linear regression analyses, Peoria Lake is filling faster in the more recent of two time spans, but Lake Meredosia's increasing sedimentation rate is shown only by a linear regression. The probable cause for increasing sediment loads in the Illinois River is an almost twofold increase in row crop production in Illinois. (Sims-ISWS)
W80-06303

LOW SEDIMENT TRANSPORT RATES OVER FLAT BEDS,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
P. A. Mantz.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY7, Proceedings Paper 15526, p 1173-1190, July 1980. 6 Fig, 2 Tab, 20 Ref, 2 Append.

Descriptors: *Bed load, *Beds, *Flow, Dimensional analysis, *Sediment transport, Shear stress, Stability, Sedimentation, Hydraulics, Model studies, Bed stability.

Flat sediment beds composed of lightweight plastic discs were laid under two conditions of water flow and subsequently eroded as bed load. The low sediment transport rates were correlated with the increasingly applied fluid shear stress and shown to differ with the two bed laying or initial bed stability conditions. These results were nondimensionalized to enable application to field situations and comparison with previous studies that used natural density, near-spherical grains as the sediment. Scale parameters were chosen for the dimensionless analysis using the results of a study on the motion of solitary discs and previous solitary grain studies under water flow. Universal curves were finally proposed for predicting a critical dimensionless shear stress at a given low transport rate and bed stability or armoring condition. (Lee-ISWS).
W80-06383

SEDIMENTATION OF DETRITAL PARTICULATE MATTER IN LAKES: INFLUENCE OF CURRENTS PRODUCED BY INFLOWING RIVERS,
Bern Univ. (Switzerland). Geologisches Inst.
For primary bibliographic entry see Field 2H.
W80-06390

SYSTEM MODEL OF DAILY SEDIMENT YIELD,
National Council for Scientific Research, Lusaka (Zambia).
T. C. Sharma, and W. T. Dickinson.
Water Resources Research, Vol 16, No 3, p 501-506, June 1980. 4 Fig, 3 Tab, 16 Ref.

Descriptors: *Canada, *Fluvial sediments, *Sediment yield, *Input-output analysis, Sedimentation, Computer models, Hydrology, Model studies, Systems analysis, Mathematical models, Runoff, *Input-output system, Daily sediment model, Watershed fluvial system.

Input-output systems concepts have been applied to the modeling of daily runoff-sediment yield of the Thames River in southern Ontario, Canada. Spectral and correlation techniques have been used to construct a parsimonious model of daily sediment yields. It was shown that a linear discrete dynamic model is possible in terms of the log-transformed daily runoff and sediment yield sequences. The fluvial system of the Thames River watershed exhibits a weak memory on a daily basis, and the noise component corrupting the watershed fluvial system resembles a white noise process. (Lee-ISWS).
W80-06401

SOURCE IDENTIFICATION FOR SUSPENDED SEDIMENTS,
Severn-Trent Water Authority, Nottingham (England).
D. L. Grimshaw, and J. Lewin.
Journal of Hydrology, Vol 47, No 1/2, p 151-162, May 1980. 5 Fig, 3 Tab, 19 Ref.

Descriptors: *Suspended solids, *Erosion, *Watersheds(Basins), *Europe, Sediments, Sediment yield, Sedimentation, Hydrology, Sediment discharge, Sampling, *Sediment source.

Studies of suspended sediment in the 170-sq km River Ystwyth catchment (mid-Wales) for 1973-1975 suggest two complementary methods of identifying their sources. The color of yielded sediments and the details of sediment-discharge relationships with respect to time, allow a separation into 'channel' and 'nonchannel' sources. In two successive years, yields of 43,439 and 12,233 t are estimates, with 'channel' sediments contributing 40.5 and 53.3%, respectively. Explanations for such yields and the more general applicability of the methods used were discussed. (Lee-ISWS).
W80-06406

RESERVOIR EFFECTS ON SEDIMENT YIELD,
Severn-Trent Water Authority, Nottingham (England).
D. L. Grimshaw, and J. Lewin.
Journal of Hydrology, Vol 47, No 1/2, p 163-171, May 1980. 4 Fig, 3 Tab, 7 Ref.

Descriptors: *Sedimentation, *Europe, *Reservoir silting, Reservoirs, Effects, Sediment yield, Sediment discharge, Sediment transport, Hydrology, Watersheds (Basins), Rivers, Sediments, *Reservoir sedimentation, *Great Britain.

Sediment yields for two years from the adjacent and generally comparable Rheidol and Ystwyth catchments were examined to assess the downstream effects of impounding and regulation of discharges from 84% of the Rheidol catchment. Suspended sediment yields are highly variable from year to year, but from the Ystwyth were 16 and 7 times those from the Rheidol (43,400 t and 12,200 t on the Ystwyth, by comparison with 2700 t and 1700 t). Bed sediment movement was estimated using Schoklitsch relationships, together with tracer experiments, and showed even larger differences. These dissimilarities are attributed partly to the isolation of dominant upland sediment sources

in the case of suspended sediment and to a decrease in high magnitude discharges and stream power available for sediment transport. Such effects are likely to be common to the numerous reservoired catchments of upland Britain. (Lee-ISWS).
W80-06407

GRAIN SIZE AND MINERALOGY OF SEDIMENT CORES FROM WESTERN LAKE HURON,
Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
For primary bibliographic entry see Field 2H.
W80-06442

2K. Chemical Processes

THE SPATIAL DIMENSION IN THE INTERPRETATION OF STREAM SOLUTE BEHAVIOUR,
Exeter Univ. (England). Dept. of Geography.
D. E. Walling, and B. W. Webb.
Journal of Hydrology, Vol 47, No 1/2, p 129-149, May 1980. 8 Fig, 1 Tab, 63 Ref.

Descriptors: *Solutes, *Streamflow, *Rivers, *Watersheds(Basins), Drainage, Hydrographs, Runoff, Water chemistry, Chemicals, Discharge(Water), Specific conductivity, Hysteresis, Storm runoff, Groundwater, Hydrology, *England, *Exe River(England).

Solute studies are becoming increasingly important, and it is frequently attempted to interpret the solute response measured at a downstream station in terms of the runoff processes operating in the drainage basin upstream. To be meaningful, such attempts should consider the effects of aggregation of upstream solute responses and channel routing. Many studies have ignored these spatial aspects and have focused on a limped representation of the drainage basin system and on the processes operating in a vertical profile of vegetation, soil, and rock. Data collected from the River Exe in England were used to demonstrate the importance of aggregation of the solute behavior of upstream tributaries in the interpretation and explanation of solute rating curves, storm-period hysteretic loops, and chemographs for individual events. The significance of channel routing effects in causing changes in the relative timing of the discharge hydrograph and the chemograph were also highlighted using examples from the Rivers Exe and Culm. (Sims-ISWS)
W80-06203

DRINKING WATER QUALITY AND VARIATIONS IN WATER LEVELS IN THE FRACTURED CRYSTALLINE-ROCK AQUIFER, WEST-CENTRAL JEFFERSON COUNTY, COLORADO,
Geological Survey, Lakewood, CO, Water Resources Div.
For primary bibliographic entry see Field 2F.
W80-06343

BOTTLED WATER: EXPENSIVE GROUND WATER,
Shell Oil Co., New Orleans, LA.
For primary bibliographic entry see Field 1B.
W80-06422

GROUND WATER: THE SEISMOLOGIST'S TOOL OF THE FUTURE,
National Water Well Association, Worthington, OH.
For primary bibliographic entry see Field 7B.
W80-06424

2L. Estuaries

PROCEEDINGS OF THE GULF OF MEXICO COASTAL ECOSYSTEMS WORKSHOP, PORT ARANSAS, TX, SEPTEMBER 4-7, 1979.
Texas Univ., Port Aransas. Marine Science Inst.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-197692, Price codes: A10 in paper copy, A01 in microfiche. Fish and Wildlife Service Report FWS/OBS-80/30, May 1980. Fore, P. L. and Peterson, R. D., eds. 220 p, 26 Fig, 8 Tab, 406 Ref, 3 Append. 14-16-0002-79-152.

Descriptors: *Water resources, *Coasts, *Ecology, *Shores, Coastal marshes, Ponds, Lagoons, *Ecosystems, Swamps, Marshes, Fish, Salinity, Aquatic habitats, Saline water intrusion, Grasses, Brackish water, Estuaries, Forestry, Productivity, Permits, State governments, Control, Oil, *Gulf of Mexico.

The proceedings from the September 1979 workshop on Gulf of Mexico Coastal Ecosystems sponsored by the U.S. Fish and Wildlife Service is presented in this report. Recent developments in the assessment of the impact of human activities on fish and wildlife resources of the Gulf Coast ecosystems was discussed. Fourteen presentations were given during the workshop and two afternoons were devoted to field trips to representative coastal habitats of the south Texas region. The topics discussed include the impact of marsh impoundments, freshwater inflow requirements in Corpus Christi Bay, wooded swamps and bottomland forest contributions to estuarine productivity, ecology of the hypersaline Laguna Madre, productivity of seagrasses, dynamics of the Gulf of Mexico off the Texas coast, and the ecological values of selected coastal habitats. Resource management, adaptive environmental assessment, legal aspects of the permitting process, State and Federal relations in the coastal area, and oil and gas development in coastal marshes were also discussed. These proceedings are of special interest to coastal decision-makers. (Sidney-IPA)
W80-06228

EFFECT OF THE SPARTINA ALTERNIFLORA ROOT-RHIZOME SYSTEM ON SALT MARSH SOIL DENITRIFYING BACTERIA,
Georgia Univ., Athens. Dept of Microbiology.
For primary bibliographic entry see Field 2I.
W80-06258

FLOWSLIDES IN MUDS ON EXTREMELY LOW ANGLE TIDAL FLATS, NORTHEASTERN SOUTH AMERICA,
Louisiana State Univ., Baton Rouge. Coastal Studies Inst.
J. T. Wells, D. B. Prior, and J. M. Coleman.
Geology, Vol 8, No 6, p 272-275, June 1980. 7 Fig, 13 Ref.

Descriptors: *Mudflows, *Coasts, *South America, *Sediment transport, Tidal waters, On-site investigations, Surveys, Mud flats, Geomorphology, Coastal processes.

Observations during field experiments on tidal flats in northeastern South America revealed that subaqueous mass-movement processes occur in soft, fluid muds on slopes of only 0.03 deg to 0.08 deg. Systems of linear failure chutes bounded by well-formed shear zones become visible during low tide and carry muds seaward at average rates of 1 to 10 cm/min. In situ measurements of pressure within the mud suggest that excess pore-water pressures which develop as tide waters recede may initiate this offshore movement of mud described as 'flowsliding.' Flowslide movement in significant as a transport mechanism for returning tidal flat muds to the wave-dominated environment from which they were derived. (Humphreys-ISWS)
W80-06290

OBSERVATIONS OF WIND-WAVES AND SWELL AT AN EXPOSED COASTAL LOCATION,
Institute of Oceanographic Sciences, Wormley (England).
J. A. Ewing.
Estuaring and Coastal Marine Science, Vol 10, No 5, p 543-554, May 1980. 9 Fig, 3 Tab, 13 Ref.

Descriptors: *Waves(Water), *Ocean waves, *Winds, *Meaurement, Instrumentation, Oceans, Coasts, Oceanography, *Great Britain coast, *South Uist, Wind-generated waves, Swell waves, Wave spectra, Wind measurement, Wave measurement.

Wave measurements were made with a waverider buoy 20 km off South Uist for a period of one year in conjunction with wind measurements obtained from a nearby meteorological station on land. A knowledge of the local wind speed usually makes it possible to identify the wind-sea and swell regious of the wave spectrum. A study of fetch-limited waves caused by east winds showed, after wind speed measurements over land were adjusted to be representative of conditions over the sea, that the main characteristics of wind-generated waves agree with fetch-limited relations found in the Joint North Sea Wave Project. At longer fetches, and also for waves generated by west winds, the wave height and period of the wind waves were consistent with fully developed values derived for the Pierson-Moskowitz spctrum. Swell waves at South Uist were considered in relation to winds at oceans weather station Lima. The amplitude of the fluctuations in swell heights was found to be linearly related to the onshore component of wind speed at station Lima. (Sims-ISWS)
W80-06292

A NUMERICAL MODEL OF CIRCULATION IN A CONTINENTAL SHELF-SILLED FJORD COUPLED SYSTEM,
Alaska Univ., Fairbanks. Inst. of Marine Science.
H. J. Niebauer.
Estuarine and Coastal Marine Science, Vol. 10, No. 5, p 507-521, May 1980. 12 Fig, 26 Ref.

Descriptors: *Fjords, *Water circulation, *Alaska, *Model studies, Mathematical models, Numerical analysis, Computer models, Currents(Water), Upwelling, Mixing, Salinity, Coriolis force, Winds, Flow, Estuaries, Sills, Fjord sills.

A numerical model of continental shelf-silled fjord coupled systems was constructed motivated by the great range of oxic and anoxic fjord deep water conditions and bottom water renewal processes found in silled estuaries. The model was a cross-sectional, time dependent, nonlinear, finite-difference model that included friction, stratification, and topography but assumed no longshore propagation or advection. While the model was of a general nature, this study considered a specific case of a high latitude subarctic fjord opening on to the Gulf of Alaska shelf. The experiments simulating fjord circulation focused on bottom water renewal and included modeling the inflow of denser shelf water over the sill into the fjord basin by both static (initial conditions) and dynamic processes (freshwater inflow and long-fjord winds inside the fjord, and longshore winds on the adjacent shelf). The results of the modeling experiments suggested that Coriolis force should be considered in modeling narrow fjord basins. Winds within the fjord were important in the surface circulation but in the stratified case had little effect on deep circulation. The effect of freshwater inflow to Resurrection Bay was shown to be minimal. Meteorological forcing of hydrographic conditions on the adjacent shelf (coastal upwelling and downwelling) greatly affects fjord-wide circulation, especially bottom water circulation and renewal. The results suggested that deep water renewal is nearly continuous year-round, although the driving forces (e.g., wind driven coastal upwelling and downwelling) and associated results (e.g., variations in hydrography) are strongly seasonal. Comparison of hydrographic, meteorological, and current data from the Resurrection Bay-continental shelf system with the model results showed agreement. (Sims-ISWS).
W80-06293

SALT FLUX AND MIXING IN THE COLUMBIA RIVER ESTUARY,
Department of Energy, Washington, DC. Office of Military Application.
F. W. Hughes, and M. Rattray, Jr.
Estuarine and Coastal Marine Science, Vol 10, No 5, p 479-493, May 1980. 9 Fig, 3 Tab, 19 Ref. Army At (45-1)-1725, NSF OCE77-17660.

Descriptors: *Estuaries, *Columbia River, *Water circulation, *Salinity, Salts, Tidal waters, Rivers, Tidal effects, Stratification, Circulation, Currents (Water), Tides, Mixing, Sampling, Data processing, Correlation analysis, Coasts, Salt flux.

The Columbia River Estuary at low discharge falls in classes 1b and 2b of the Hansen & Rattray classification system with the former occurring upstream where the salinity gradients are weakest. During high discharge it falls in the relatively unexplored region bounding classes 1b, 2b, and 4. It is typified by both strong tidal and mean currents modified by bathymetry and channel curvature. The dominant lateral dynamic balance is between the pressure gradient, centrifugal and Coriolis forces. The estuary has a strong vertical salinity gradient and also a marked transverse gradient required for the lateral dynamic balance. More than half the upstream salt flux, balancing the downstream mean flow advective salt flux, is directly due to correlations between tidal components of velocity and salinity and between each of these and the tidal variation of cross-sectional area. The remaining upstream salt flux arises from the vertical gravitational circulation. The mean stratification and circulation for both high and low discharges yielded theoretical estimates of the diffusive fraction of the upstream salt flux in reasonable agreement with the observed values. They also lead to reasonable estimates of P and F sub m for low discharge conditions, but for high discharge only the estimate of P was reasonable. Neither the high discharge estimate of F sub m nor the vertical profiles of velocity, U, and salinity, S, fit the theoretical models. (Sims-ISWS).
W80-06294

A STATISTICAL METHOD TO ESTIMATE THE BIOCHEMICAL COMPOSITION OF PHYTOPLANKTON IN THE SOUTHERN BIGHT OF THE NORTH SEA,
Brussels Univ. (Belgium). Lab. of Oceanography.
C. Lancelot-Van Beveren.
Estuarine and Coastal Marine Science, Vol 10, No 5, p 467-478, May 1980. 8 Fig, 4 Tab, 18 Ref.

Descriptors: *Phytoplankton, *Biochemistry, *Oceans, *Coasts, Sampling, Surveys, Chemical analysis, Data processing, Regression analysis, Chlorophyll, Lipids, Proteins, Carbohydrates, Primary productivity, Bacteria, Variability, Seasonal, Ecology, Oceanography, *North Sea.

The knowledge of changes in the biochemical composition of phytoplankton and its degraded products is regarded as important for the understanding of an ecosystem because it influences the heterotrophic activities of the seawater column and/or sediments. The linear regressions method of some specific metabolite (protein, carbohydrate, lipid) on chlorophyll a was considered as the better method to estimate the biochemical composition of natural phytoplankton in the coastal area of the Southern Bight of the North Sea. The validity of this statistical method depends on a correct assemblage of the results in time and space and requires a good knowledge of the growth conditions of the phytoplankton cells. This essential condition is, however, difficult to realize for postbloom periods where the growth conditions are more heterogeneous. The linear regressions lead, on the one hand, to the quantification of two components of the total particulate organic matter (phytoplankton and bacteria/detritus) and, on the other hand, to their biochemical characterization. The comparison of the biochemical composition of the two components showed that bacteria/detritus component has an effective nutritive value when phytoplankton is less abundant. The study of the influence of changes in the environmental conditions (light intensity and nitrogen availability) on the biochemical composition of the phytoplankton showed a similar protein content of about 50% when nitrogen is not limiting. A change in the light intensity does not change the biochemical composition of natural phytoplankton but increases the cellular chlorophyll content when nitrogen is sufficient to ensure a good phytoplanktonic growth. (Sims-ISWS).
W80-06295

PROPERTIES AND CIRCULATION OF SAN FRANCISCO BAY WATERS,
Geological Survey, Menlo Park, CA, Water Resources Div.
T. J. Conomos.
In: San Francisco Bay: The Urbanized Estuary: Proceedings of the Fifty-Eighth Annual Meeting of the Pacific Division/American Association for the Advancement of Science, held at San Francisco State University, San Francisco, CA, June 12-16, 1977; published by California Academy of Sciences, San Francisco. p 47-84, 1979, 28 Fig, 5 Tab, 91 Ref.

Descriptors: *Water circulation, *Bays, *California, *Water pollution sources, Salinity, Estuaries, Mixing, Saline water-freshwater interfaces, Waste water(pollution), Tidal effects, Currents(water), *San Francisco Bay(CA).

The northern reach of the San Francisco Bay receives 90% of the mean annual river inflow and 24% of the waste-water inflow. It changes from a partially mixed estuary, with a vertical salinity gradient of 10 per mil during high river inflow to well mixed estuary with a vertical salinity gradient of 3 per mil during low summer inflow. The southern reach also has seasonally varying wate properties. The variations are determined by water exchange from the northern reach and the ocean and by direct waste inflow (76% of total bay waste inputs). Salinity stratification is present during winter, whereas during summer the water is nearly isohaline because of wind and tidal mixing. Our knowledge of transport mechanisms is fragmentary. The northern reach has a permanent estuarine circulation cell largely maintained by the salinity-controlled density differences between river and ocean waters. Although wind variations alter this circulation, it is largely modulated by the timing and magnitude of the highly-seasonal river inflow. This nontidal circulation is nearly equivalent to tidal diffusion in controlling the water-replacement rates in the channels, which vary from weeks (winter) to months (summer). The southern reach, in contrast, has seasonally reversing but sluggish near-bottom and surface nontidal currents that are generated by prevailing summer and episodic winter-storm winds and by winter flows of Delta-derived low salinity water from the northern reach. Although the diffusion of substances by the strong tidal currents is notable, the relative importance of diffusion by strong tidal currents and the episodic advective processes in controlling water replacement mechanisms and rates has not yet been fully determined. (Kosco-USGS).
W80-06334

THE MOVEMENT AND EQUILIBRIUM OF BEDFORMS IN CENTRAL SAN FRANCISCO BAY,
Geological Survey, Menlo Park, CA, Water Resources Div.
D. M. Rubin, and D. S. McCulloch.
In: San Francisco Bay: The Urbanized Estuary: Proceedings of the Fifty-Eighth Annual Meeting of the Pacific Division/American Association of the Advancement of Science, held at San Francisco State University, San Francisco, CA, June 12-16, 1977; published by California Academy of Sciences, San Francisco. p 97-113, 1979, 14 Fig, 42 Ref.

Descriptors: *Movement, *Equilibrium, *Beds, *Bays, *California, *Sands, Sediment transport, Tidal effects, Currents (water), Water circulation, *Central San Francisco Bay(CA), *Bedforms, Sediment distribution, Bottom sediments, San Francisco Bay.

The sand-covered floor of Central San Francisco Bay is molded by tidal currents into a series of bedforms, each of which is stable through a discrete range of tidal velocity, grain size, and water depth. Many of the bedforms move during average tide cycles, and do not require storms, floods or abnormal flow conditions to be active. The net direction of bottom sediment transport has been deduced from bedform asymmetry. The geometry of Central Bay exerts considerable control on the sediment transport pattern. Tidal flows accelerate as they pass through the narrow Golden Gate and produce ebb and flood jets that transport sediment away from the Gate. Lower velocity flows that occur between the shoreline and the jets are ebb dominant within the Bay, and flood dominant outside the Gate, and these flows transport sediment toward the Gate. In Central Bay, where many of the bedforms are active during average tide cycles, sediment turnover, which is important in organic and inorganic exchange between the sediment and the water column, results largely from bedform migration. This rigorous hydraulic regime also acts to reduce biological turnover by benthic organisms by producing an environment more suited to animals that extract nutrients from the water column and surface and suspended sediment, rather than from buried sediment. (Kosco-USGS).
W80-06335

PROCESSES AFFECTING SEASONAL DISTRIBUTIONS OF WATER PROPERTIES IN THE SAN FRANCISCO BAY ESTUARINE SYSTEM,
Geological Survey, Menlo Park, CA, Water Resources Div.
T. J. Conomos, R. E. Smith, D. H. Peterson, S. W. Hager, and L. E. Schemel.
In: San Francisco Bay: The Urbanized Estuary: Proceedings of the Fifty-Eighth Annual Meeting of the Pacific Division/American Association for the Advancement of Science, held at San Francisco State University, San Francisco, CA, June 12-16, 1977; published by California Academy of Sciences, San Francisco. p 115-142, 1979, 18 Fig, 3 Tab, 51 Ref.

Descriptors: *Water properties, *Bays, *California, *Seasonal, *Distribution patterns, Estuaries, Estuarine environment, Suspended load, Water circulation, Nutrients, Phosphates, Nitrates, Benthos, Hydrographs, *San Francisco Bay(CA), Seasonal variations.

Delta outflow directly controls and often dominates the spatial and temporal distribution of most properties and biological processes in the northern reach of the San Francisco Bay. The outflow contributes suspended particles, dissolved oxygen, and silicate, and generates an estuarine circulation cell and a turbidity maximum. The circulation pattern and associated features largely dictate spatial distributions. Seasonal changes, however, are caused by relative changes in outflow (which determine water-residence time and thus flushing rates) and light-limited biological activity (photosynthesis, nutrient uptake, and oxygen production): during winter, mixing and advection control biological activity, whereas during summer, both biological activity and physical processes are important. The relation between Delta outflow and biological processes in the southern reach, however, is less direct; biological activity has a relatively greater effect on the spatial and temporal distributions of these properties. Distributions of properties are dominated by the perennial inflow of detritus and nutrient-rich waste water at the southern boundary. These inputs are augmented during winter by discharges from local intermittent streams that may contribute large amounts of nitrogenous compounds. The substrate is the major source of particles and dissolved silicate. Greatest biological activity apparently takes place during spring rather than summer as in the northern reach. This increased activity in the southern reach is caused in part by Delta outflow induced stratification that tends to maintain algal cells in the photic zone. (Kosco-USGS).
W80-06336

SOURCES AND SINKS OF BIOLOGICALLY REACTIVE OXYGEN, CARBON, NITROGEN, AND SILICA IN NORTHERN SAN FRANCISCO BAY,
Geological Survey, Menlo Park, CA, Water Resources Div.
D. H. Peterson.
In: San Francisco Bay: The Urbanized Estuary: Proceedings of the Fifty-Eighth Annual Meeting of the Pacific Division/American Association for the Advancement of Science, held at San Francisco State University, San Francisco, CA, June 12-16, 1977; published by California Academy of Sciences, San Francisco. p 175-193, 1979, 8 Fig, 5

Tab, 52 Ref.

Descriptors: *Sinks, *Estuarine environment, *Bays, *California, Oxygen, Carbon, Nitrogen, Silica, Seasonal, River flow, Distribution patterns, Phytoplankton, Nitrates, Ammonia, Bottom sediments, *Northern San Francisco Bay(CA), San Francisco Bay.

The distributions of biologically reactive dissolved oxygen, carbon, nitrogen, and silica (OCNSi) in the main channels of northern San Francisco Bay appear to be related to winter and summer variations in the dynamics of the estuary. At moderate or higher (>500 cu m/s) river flow, OCNSi distributions in the estuary frequently are nearly conservative. Thus, during high-flow periods, the relative effects of additional estuarine sources and sinks (waste inputs, phytoplankton production and remineralization, or atmospheric and benthic exchange processes) appear to be minimal. At such river flows, replacement time for estuarine water is on the order of weeks, whereas the OCNSi replacement (turnover) times due to additional sources and sinks are longer. The turnover time of NH3-N, however, is shorter. The river and ocean are probably not major sources of NH3 to the estuary. Marked departures from near-conservative OCNSi distributions occur during low river flow (<200 cu m/s), when the magnitudes of the local sources and sinks may exceed river and ocean inputs. As an overview, however, one is left with the impressions that several processes control these distributions at comparable rates and that no one factor dominates: dissolved oxygen is typically 5 to 10% below saturation concentrations; dissolved CO2 is 150 to 200% above saturation concentrations and in approximate balance with oxygen consumption; phytoplankton production keeps pace with waste inputs of nitrogen; and dissolved silica is maintained above concentrations which would be limiting for phytoplankton growth. (USGS).
W80-06337

DISTRIBUTIONS AND STABLE-ISOTOPE COMPOSITION OF CARBON IN SAN FRANCISCO BAY,
Geological Survey, Reston, VA, Geologic Div.
For primary bibliographic entry see Field 5C.
W80-06338

FLUCTUATIONS OF COPPER, ZINC, AND SILVER IN TELLENID CLAMS AS RELATED TO FRESHWATER DISCHARGE-SOUTH SAN FRANCISCO BAY,
Geological Survey, Menlo Park, CA, Water Resources Div.
For primary bibliographic entry see Field 5C.
W80-06339

PHYTOPLANKTON ECOLOGY OF THE SAN FRANCISCO BAY SYSTEM: THE STATUS OF OUR CURRENT UNDERSTANDING,
Geological Survey, Menlo Park, CA, Water Resources Div.
J. E. Cloern.
In: San Francisco Bay: The Urbanized Estuary: Proceedings of the Fifty-Eighth Annual Meeting of the Pacific Division/American Association for the Advancement of Science, held at San Francisco State University, San Francisco, CA, June 12-16, 1977: published by California Academy of Sciences, San Francisco. p 247-264, 1979, 13 Fig, 1 Tab, 42 Ref.

Descriptors: *Phytoplankton, *Ecology, *Bays, *California, Estuarine environment, Water circulation, Salinity, Turbidity, Distribution patterns, Photosynthesis, Plant growth, *San Francisco Bay(CA).

Past and ongoing studies suggest that patterns exist in both the spatial and temporal variations of plankton density and species composition in the San Francisco Bay system. Predominant spatial features include a summer maximum standing stock in the vicinity of Suisun Bay that results from estuarine circulation, and a gradient of varying species composition that parallels the longitudinal salinity gradient of the northern reach of San Francisco Bay. Suisun Bay, the site of largest standing stocks, has lower rates of primary production than other parts of the estuary; this is probably a consequence of Suisun Bay's turbid waters. The few existing studies of spatial heterogeneity suggest that shoal areas around San Pablo and Suisun Bays may be sites of very high standing stocks and primary productivity, and that vertical heterogeneity is common in the northern reach when vertical salinity stratification exists, i.e., during periods of high Delta outflow. The temporal variation of phytoplankton standing stock is different in Suisun Bay than in other parts of the system. Suisun Bay typically has maximum standing stocks in late summer, coincident with the timing of maxima in the Sacramento-San Joaquin Delta. But the South, Central, and San Pablo Bays typically have annual phytoplankton maxima several months earlier, and these may be a consequence of offshore blooms, created by episodes of upwelling, that disperse into the Bay. Particularly important unanswered questions relate to the location of areas where productivity is highest, to the identification of those phytoplankton species that are responsible for autotrophic carbon fixation, and to the identification of factors that limit phytoplankton growth. (Kosco-USGS).
W80-06340

HISTORY, LANDFORMS, AND VEGETATION OF THE ESTUARY'S TIDAL MARSHES,
Geological Survey, Menlo Park, CA. Water Resources Div.
B. F. Atwater, S. G. Conard, J. N. Dowden, C. W. Hedel, and R. L. MacDonald.
In: San Francisco Bay: The Urbanized Estuary: Proceedings of the Fifty-Eighth Annual Meeting of the Pacific Division/American Association for the Advancement of Science, held at San Francisco State University, San Francisco, CA, June 12-16, 1977: published by California Academy of Sciences, San Francisco. p 347-385, 1979, 13 Fig, 4 Tab, 92 Ref. Append.

Descriptors: *Geomorphology, *Vegetation, *Estuaries, *Tidal marshes, *California, Bays, Sedimentation, Sediment transport, Urbanization, Environmental effects, Currents(water), Tidal effects, Plant morphology, Vascular tissues, Distribution patterns, Carbon, *San Francisco Bay(CA).

Around 8,000 to 10,000 years ago, sharply rising sea levels nursed a newborn San Francisco Bay estuary whose tidal marshes probably covered less ares than open water. Thereafter the rate of submergence decreased about 10-fold, and by 6,000 years ago sediment began to maintain marshes that later spread across marginal parts of San Francisco Bay. By thus counteracting or overtaking submergence, sedimentation created marshes that, as of 1850, covered about 2200 sq km, nearly twice as much area as the bays. People have leveed or filled all but approximately 85 sq km of these marshes during the past 125 years. Concurrently, human activities have caused the delivery of enormous quantities of sediment to the bays and the slackening of tidal currents in sloughs, thereby contributing to the creation of nearly 75 sq km of marsh, about half of which remains pristine. Plains situated near high-tide levels are the most extensive landforms of both historic and modern marshes. Tides rather than upland tributaries created most sloughs around the bays, but riverine floods erected natural levees that confined tidal water in the Delta. Tidal marshes around San Francisco Bay typically contain 13 or 14 species of vascular plants characteristic of salt marshes and are dominated by common pickleweed (Salicornia pacifica) and California cordgrass (Spartina foliosa). In the Delta, tidal marshes support about 40 species characteristic of freshwater marshes and are dominated by tules and bulrushes (Scirpus spp.), cat-tails (Typha spp.), and common reed (Phragmites communis). These contrasting communities overlap around San Pablo Bay, Carquinez Strait, and Suisun Bay. Damage to tules and bulrushes during the drought of 1976-1977 confirms that intolerance of salt causes these plants to disappear toward San Francisco Bay. The disappearance of California cordgrass and common pickleweed toward the Delta, alternatively, may result from unsuccessful competition against tules, bulrushes, and other species. If export equals one quarter of net above-ground productivity, then vascular plants of the tidal marshes collectively contribute about 10 billion grams of carbon per year to other parts of the estuary. (Kosco-USGS)
W80-06341

NATURAL AND ANTHROPOGENIC INFLUENCES ON BENTHIC COMMUNITY STRUCTURE IN SAN FRANCISCO BAY,
Geological Survey, Menlo Park, Ca. Geologic Div.
For primary bibliographic entry see Field 5C.
W80-06342

THE STATISTICAL PREDICTION OF BEACH CHANGES IN SOUTHERN CALIFORNIA,
Woods Hole Oceanographic Institution, MA. Dept. of Geology and Geophysics.
D. G. Aubrey, D. L. Inman, and C. D. Winant.
Journal of Geophysical Research, Vol 85, No C6, p 3264-3276, June 20, 1980. 13 Fig, 5 Tab, 17 Ref.

Descriptors: *Beaches, *Beach erosion, *Geomorphology, *California, *Model studies, Statistical models, Mathematical models, Waves(Water), Ocean waves, Forecasting, Energy, Radiation, Profiles, Coasts, Statistics, Equations, Beach change prediction, Beach profiles.

Changes in natural sand beaches induced by variations in incident waves were predicted by techniques of linear statistical estimation and empirical eigenfunction analysis. A 5-year set of measured beach profiles and wave statistics from southern California constituted the data base for this two-faceted statistical study. First, daily beach profile changes were predicted using four different spectral representations of the wave field. These profile changes were predictable using spectral representations of wave energy, radiation stress, energy flux, and wave steepness. Because of constraints on statistical reliability, a longer data set is required to select one of these as an optimal wave parameterization. Second, weekly beach profile changes were predicted using weekly averaged wave characteristics. Weekly beach changes were predictable using weekly mean and maximum values of wave energy and wave height. The best predictor of those tested was the weekly mean wave energy. When combined with a longshore transport model, this onshore/offshore transport estimator should be applicable to other coastal regions with different beach and wave characteristics. (Sims-ISWS).
W80-06378

ASYMMETRIC VARIATION OF GHYBEN-HERZBERG LENS,
Rhode Island Univ., Kingston. Dept. of Civil and Environmental Engineering.
D. W. Urish.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY7, Proceedings Paper 15533, p 1149-1158, July 1980. 5 Fig, 1 Tab, 13 Ref, 2 Append.

Descriptors: *Barrier islands, *Beaches, *Saline water-freshwater interfaces, *Tidal effects, *Groundwater, *Rhode Island, Freshwater, Water table, Equations, Dupuit-Forchheimer theory, Groundwater movement, Lagoons, Sea level, Waves(Water), Permeability, Recharge, Density, Water levels, *Ghyben-Herzberg equation, Asymmetric lens, Wave runup.

An asymmetric freshwater lens was shown to exist in a long, narrow coastal barrier beach bounded on one side by a saltwater lagoon and on the other by the ocean. Field measurements of groundwater specific conductance and water table elevations showed the lens to average approximately 17 ft (5 m) in maximum thickness and to be thicker on the side toward the lagoon. The asymmetry is apparently due to an effective mean sea level higher than actual mean sea level on the ocean side which occurs because of tide and wave action on a sloping ocean beach. An approximate analytical model enabling calculation of the asymmetric lens was described that utilizes the Ghyben-Herzberg relation with Dupuit assumptions and input parameters

of permeability, recharge, landmass width, freshwater and seawater densities, and effective lagoon/ocean level difference. (Visocky-ISWS).
W80-06384

WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

IN SITU FORMATION OF CELLULOSE ACETATE CARBAMATE DRY-RO MEMBRANES,
Puropore, Inc., Tustin, CA.
R. E. Kesting, J. Ditter, A. Murray, and J. Newman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-211238, Price codes: A04 in paper copy, A01 in microfiche. Final Report prepared for the U.S. Department of the Interior, Office of Water Research and Technology, Washington, DC, May 1980. 50 p, 3 Fig, 19 Tab, 31 Ref. OWRT C-90006-S(9402)(1). 14-34-0001-9402.

Descriptors: *Membranes, *Reverse osmosis, *Permselective membranes, Cellulose, Ion transport, Salinity, Polymers, Chemical properties, Research and development, Materials testing, Prototypes, *Desalination, Dry process, In situ formation, Cellulose acetate, Carbamates, Sulfonates, Membrane structure evolution.

The in situ formation of cellulose acetate (CA) carbamates was investigated to increase the performance of Dry-Ro membranes of CA. The CA casting solutions were charged with reversibly blocked isocyanate monomers, which when heated, formed CA carbamates. This approach is economical since it uses a small amount of inexpensive blocked isocyanate monomer for a large amount of preformed polymer, CA carbamate. The performance of modified CA membranes was tested on several levels (neutral, neutral in situ, sulfonated, sulfonated in situ, quarternized in situ) to establish a basis for comparison. The modification of the CA membranes with neutral carbamate groups decreased the permeability but not the permselectivity. Monofunctional isocyanate monomers were not as efficient as diisocyanate monomers in carbamate formation and the later technique appears to be the most promising. Sulfonated CA carbamates gave poor RO efficiency and solubility and their formation was not efficient. CA carbamates formed in situ with quaternary ammonium groups appeared quite promising and a nonswelling QCAC Dry-Ro membrane from a commercial polyurethane prepolymer containing two isocyanate groups and a single quaternary ammonium group was prepared. (Sidney-IPA)
W80-06225

DEVELOPMENT OF COMPOSITE HOLLOW FIBER REVERSE OSMOSIS SYSTEMS,
FRL, An Albany International Co., Dedham, MA.
D. K. Schiffer, R. B. Davis, and M. J. Coplan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-213044, Price codes: A03 in paper copy, A01 in microfiche. Final Report to Office of Water Research and Technology, June 1979. 44 p, 20 Fig. OWRT S-0118(No 7551)(1), 14-34-0001-7551.

Descriptors: *Desalination, *Reverse Osmosis, *Membrane processes, *Hollow fiber membrane, Composite membranes, Brackish water desalting, Sea water desalting, Fiber coating, Pressure shell design.

Work conducted under this contract is a continuation of the development of a hollow fiber reverse osmosis composite membrane. The membrane is a modified, sulfonated poly(furfuryl alcohol) on a microporous polysulfone substrate. The substrate was prepared by a dry jet/wet spinning process using a commercial (Union Carbide) polysulfone dissolved in a mixture of dimethyl formamide and a nonionic surfactant. The membrane was formed in situ by the sulfuric acid catalyzed polymerization of furfuryl alcohol. High flux, high rejection membranes were developed by adding flux modifiers to the reaction mixture. These membranes have the same long term instability that pure polyfuran membranes have. A series of post treatments primarily based on resorcinol/formaldehyde polymerizations that add durability were developed. Pilot scale module production of 5.0 and 7.6 cm modules was undertaken. More than one hundred modules were produced and tested by OWRT and industrial collaborators. Multiple bundle high pressure and single bundle low pressure shells were manufactured.
W80-06326

3C. Use Of Water Of Impaired Quality

SALINE-SEEP DEVELOPMENT IN THE HAILSTONE BASIN, NORTHERN STILLWATER COUNTY, MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
B. D. Lewis, S. G. Custer, and M. R. Miller.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-137581, Price Codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 79-107, November 1979. 28 p, 9 Fig, 3 Tab, 36 Ref.

Descriptors: *Saline soils, *Seepage, *Montana, *Groundwater movement, Hydrogeology, Precipitation(Atmospheric), Cultivation, Topography, Percolation, Infiltration, Soil water movement, Chemical analysis, Water quality, *Hailstone basin(CO), *Saline seeps, Data collections, Evaluation.

As a result of an increase in saline seep occurrence in Montana, a study was begun in 1974 to determine the hydrogeology of saline seeps in the Hailstone basin. The aquifer is composed of colluvium of Holocene age. The impermeable Cretaceous Niobrara Formation underlies the saturated zone basinwide. The ground-water system is shallow, unconfined, and locally recharged. Ground-water levels and size of the saline seeps respond rapidly to precipitation in the basin. The appearance and growth of saline seeps are related to precipitation patterns; the agricultural practice of summer follow; topography; the presence of a shallow, unconfined, and locally recharged ground-water system; and a soluble salt source. Continuous cropping could reduce the amount of water percolating beneath local recharge areas, and thus minimize the water available for seep formation and growth. The lateral variation in chemical quality of water from wells suggests a shallow flow system. The field specific conductance of 29 ground-water samples collected in 1976 ranged from 2,160 to 14,000 micromhos per centimeter and averaged 6,660 micromhos per centimeter. Water from saline seeps in the study area contains principally sodium, magnesium, calcium, and sulfate. Nitrate is present in the ground water in concentrations of as much as 855 milligrams per liter. The high nitrate concentrations are interpreted to originate primarily from oxidation of organic material once native sod is broken by cultivation. (USGS).
W80-06243

THE ROLE OF GROUNDWATER RECHARGE IN WASTEWATER REUSE: ISRAEL'S DAN REGION PROJECT,
Tahal Consulting Engineers Ltd., Tel-Aviv (Israel).
For primary bibliographic entry see Field 4B.
W80-06380

GROUNDWATER RECHARGE OPERATIONS IN CALIFORNIA,
California State Water Resources Control Board, Sacramento.
For primary bibliographic entry see Field 4B.
W80-06381

3E. Conservation In Industry

WATER USE IN A MULTIPRODUCT DAIRY,
North Carolina State Univ. at Raleigh.
R. E. Carawan, V. A. Jones, and A. P. Hansen.
Journal of Dairy Science, Vol 62, No 8, p 1238-1242, Aug 1979. OWRT A-058-NC(2). 14-31-0001-3533.

Descriptors: Wastewater characteristics, Wastewater monitoring, *Dairy industry, Industries, Milk separation techniques, *Water conservation, *Industrial wastes, *Water use, Wastewater reduction.

Water use was monitored in a multiproduct dairy plant by 25 cumulative use meters. Twenty-two of the meters were located in the building for product processing for study of selected operations. Fluid products accounted for 87% of production, and frozen products and by-products were 10 and 3%. Mean water use was 1.9 kg/kg product for fluid products, 10.5 kg/kg product for by-products, and 15.7 kg/kg product for frozen products. Cleaning and sanitizing operations accounted for 38% and utilities for 30% of the total process water. The milk case washer used 6.6% of the total plant water. The peak times of water use were for start-up in the morning hours and for clean-up in the early afternoon. Water saving suggestions are presented.
W80-06229

3F. Conservation In Agriculture

ROTARY SPRINKLER IMPACT ARM SPRING ADJUSTMENT,
H. C. Ridgway.
U.S. Patent No 4,181,259, 10 p, 8 fig, 4 ref; Official Gazette of the United States Patent Office, Vol 990, no 1, p 137, January 1, 1980.

Descriptors: *Patents, *Irrigation, *Sprinkler irrigation, Application equipment, Irrigation operation and maintenance, Irrigation efficiency, Nozzles.

A rotary sprinkler is provided with structure for adjusting the force applied to the impact arm by the impact arm spring. The sprinkler has a laterally directed nozzle cooperating with the arm to rotate the nozzle and an impact arm journaled on a shaft extending above the nozzle. The arm is mounted within a cage extending above the nozzle. The cage includes a pair of arms extending from the nozzle on opposite sides of the shaft and terminating at their upper ends remote from the nozzle in a top plate. A helical spring surrounds the shaft and is secured at its lower end to the arm. A bushing assembly is mounted in the top plate of the cage and receives the top end of the spring. The bushing assembly may be manually adjusted relative to the top plate to vary the force applied by the spring to the impact arm. The sprinkler is mounted in a bucket-like housing positionable within the ground so that the mouth of the housing is flush with the ground surface. The sprinkler responds to the passage of water through the nozzle by rising from a lower first position retracted in the housing to a raised second position out of the housing. A top cover sized to mate with the mouth of the housing is attached to the top plate of the cage so that when the sprinkler is in the first position the top cover mates with the mouth of the housing to enclose the sprinkler. (Sinha - OEIS).
W80-06317

PERENNIAL IRRIGATED PASTURES III. BEEF CALF PRODUCTION FROM IRRIGATED PASTURE AND WINTER ANNUAL RANGE,
California Univ., Davis. Dept. of Agronomy and Range Science.
C. A. Raguse, J. L. Hull, and R. E. Delmas.
Agronomy Journal, Vol 72, p 493-499, May-June 1980. 3 Fig, 4 Tab, (California Water Resources Center Project UCAL-WRC-W-495). OWRT-B-175-CAL (7).

Descriptors: *Legumes, Nitrogen Fixation, *Grazing, Economics, *Cattle, Ranges, *Range Management, *Irrigation effects, Pastures, Winter annual range.

The objective of this study was to compare simple and complex systems for beef calf production using a fall calving early summer weaning reproduction cycle. In the complex system, cleared and reseeded range was used an average of 6 months per year at a stocking rate of 2.2 ha/cow. Alfalfa cube supplement was fed during fall and winter. In the simple system, cleared range was used yearlong at an average stocking rate of 5 ha/cow. An average of 70 kg calf/ha was produced in the complex system. Average birth weight was 34 kg and average daily gain to 205 days was 0.76 kg. In the simple system, comparable values were 37.5 kg calf/ha, 32 kg birth weight, and 0.75 ADG. Birth weights and ADGs were not significantly different between systems. Average cow weights reflected seasonal changes in forage availability and quality. Cows in the simple system tended to lose weight more consistently during the months July-October than did those in the complex system, which, instead, more consistently lost weight during the months November-March. Economic return was similar but low in both systems. While total land per cow/calf unit was less for the complex system and total investment higher for the simple system, operating costs, depreciation, and interest were higher for the complex system.
W80-06328

EFFECTS OF DIURNAL VARIATION IN LIGHT AND TEMPERATURE ON THE ACETYLENE REDUCTION ACTIVITY OF SUBTERRANEAN CLOVER,
California Univ., Davis. Dept. of Agronomy and Range Science.
J. F. Eckart, and C. A. Raguse.
Agronomy Journal, Vol 72, p 519-523, May-June 1980. 4 Fig, (California Water Resources Center Project UCAL-WRC-W-495). OWRT-B-175-CAL (8).

Descriptors: *Nitrogen fixation, *Range management, Legumes, *Clovers, Ranges, *Diurnal, *Light intensity, *Temperature, Effects, Subterranean clover, Acetylene reduction activity.

Singly, or in combination, both light intensity or temperature can limit symbiotic N fixation. Most reported studies have been done to investigate the effects of only one of these factors. The present study was done to determine N fixation response to variation in both light and temperature for an annual range legume which, during its normal growing season, may be subject to growth limiting levels of both environmental factors. Plants of subterranean clover were grown from seed to the sixth trifoliolate seaf stage in sand with N-deficient nutrient solution. Plant containers were designed to permit sampling of the rooting atmosphere for acetylene reduction assay during treatment conditions, which were maintained with controlled-environment facilities. During the treatment phase light and temperature were investigated by: (1) varying both diurnally; (2) varying light diurnally under constant temperature; (3) varying temperature diurnally under constant light; and (4) maintaining both light and temperature constant. Apparent N2 fixation showed diurnal fluctuations under: (1) constant light; and (2) 12/12 hour light/dark regimes when root and air temperature fluctuated by 7 and 14 C, respectively. In constant temperature and either normal photoperiods or constant light, however, no significant diurnal fluctuation of acetylene reduction was measured. Under both constant temperature regimes a gradual increase in acetylene reduction activity, which may have been an artifact, was observed. These results show that diurnal changes in acetylene reduction by subterranean clover result more from fluctuations in temperature than from diurnal changes in light and suggest that N2 fixation by root nodules of this species is buffered against short-term changes in photosynthate supply.
W80-06329

GROUND WATER RESOURCE MANAGEMENT IN KANSAS,
Kansas Ground Water Management Districts Association, Topeka.
For primary bibliographic entry see Field 4B.
W80-06421

WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

A STUDY OF DETENTION IN URBAN STORMWATER MANAGEMENT,
North Carolina State Univ. at Raleigh. Dept. of Civil Engineering.
H. R. Malcom.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80 220577, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Institute, University of North Carolina Rpt. No. 156, July 1980. 78 p, 30 Fig, 13 Tab. OWRT B-093-NC(2), 14-34-0001-6106.

Descriptors: *Urban runoff, *Storm runoff, Hydrologic models, Engineering structures, Urban flooding, *Stormwater detention, Culverts, Bridges, *Flood control, *North Carolina, Water storage.

The concept of stormwater detention was analyzed for effectiveness in controlling urban flooding and stream-channel enlargement in North Carolina. Model studies, statistical analyses and theoretical analyses were conducted using gaged watersheds in Charlotte, North Carolina. Existing conventionally developed watersheds were found to have effective stormwater detention unintentionally incorporated behind culverts and bridges. Statistical analysis of long-term historical streamflows suggests that flood peaks diminished with urbanization until about 1950, when peaks began to rise again. Although detention can be shown to be present and effective by simulation and statistical analysis, stream channel enlargement and consequent high sediment loads are observable in the streams of the study area. Impulse analysis of channels subjected to discharges from hydrographs with and without detention suggests that detention can worsen streambank degradation by intensifying the impulse intensity at the channel sides near the bottom to cause more severe slumping. Stormwater detention is recommended for control of nuisance flooding immediately downstream of radical changes in land use. It should be incorporated in a comprehensive watershed management program wherein the drainage system is treated as a public utility so that economies of scale can be gained and facilities can be located strategically.
W80-06262

MULTIOBJECTIVE STATISTICAL METHOD FOR INTERIOR DRAINAGE SYSTEMS,
Case Western Reserve Univ., Cleveland, OH. Systems Engineering Div.
For primary bibliographic entry see Field 8B.
W80-06311

A MODEL FOR FLOODPLAIN MANAGEMENT IN URBANIZING AREAS,
Illinois Univ. at Urbana-Champaign. Inst. for Environmental Studies.
L. D. Hopkins, I. C. Goulter, K. B. Kurtz, H. G. Wenzel, Jr., and E. D. Brill, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80 223654, Price codes: A08 in paper copy, A01 in microfiche. Research Report 146, January 1980. 141 p, 39 Fig, 11 Tab, 52 Ref. Water Resources Center, University of Illinois, Urbana-Champaign. S-063-ILL.

Descriptors: *Flood protection, *Land use, *Optimum development plans, *Dynamic programming, Model studies, Flood routing, Nonstructural alternatives, Economic rent, Urbanization, Flood control, *Floodplain management, Watershed management.

A target land use pattern found using a dynamic programming model is shown to be a useful reference for comparing the success of floodplain management policies. At least in the test case, there is interdependence in the land use allocation for floodplain management--that is, a good solution includes some reduction of current land use in the floodplain and some provision of detention storage. For the test case, current floodplain management policies are not sufficient; some of the existing floodplain use should be removed. Although specific land use patterns are in part sensitive to potential error in land value data and to inaccuracy in the routing model, the general conclusion that some existing use must be removed is stable within the range of likely error. Trend surface analysis is shown to be a potentially useful way of generating bid price data for use in land use allocation models. Sensitivity analysis of the dynamic programming model with respect to routing of hydrographs is conducted through simulation based on expected distributions of error.
W80-06319

WATER LOSSES FROM SMALL RECREATIONAL LAKES IN ARID REGIONS AND POSSIBLE EFFECTS DOWNSTREAM,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
D. D. Evans, D. W. Young, and L. P. Onyskow.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-213242, Price codes: A06 in paper copy, A01 in microfiche. Project Completion Report, 1979. 113 p, 54 Fig, 22 Tab, 23 Ref, Append. OWRT A-065-ARIZ(1), 14-34-0001-6003, -7005 & -7006.

Descriptors: Hydrologic system, Flood routing, Surface-ground water relationships, Lake Morphology, Reservoir yield, *Model studies, Routing, *Water loss, *Lakes, *Recreation facilities, *Arid climates, Arizona, Multiple-purpose reservoirs, Hydrology, Inflow, Streamflow, High flow, Low flow, Discharge (water), Evaporation, Vegetation, Lake balance, Reservoir operations model, Flood attenuation, Watershed model, Stream flow model, *Lake Patagonia (AZ), Sonoita Creek watershed(AZ).

This project deals with an extensive case study of the Lake Patagonia/Sonoita Creek hydrologic system. Methods of instrumentation and data collection are extensively detailed, together with a good description of the geology and vegetative cover of the region. The physiography, operations and uses of the lake and surrounding land are thoroughly described. Based on measured releases and losses from Lake Patagonia, a lake balance was developed, which yielded an estimate of input to the lake for the years 1976-1977. Based on this balance, an operations model for the lake was developed which optimized multipurpose water uses (recreation, domestic stockwaterings, and environmental). The impact by the lake on flood flows was also investigated which indicates that high flood flows (>50 yr) are attenuated little by the reservoir. Based on historic and current meteorological and discharge data, an empirical watershed model is proposed which, when coupled to reservoir and stream channel parameters, will be usable to evaluate proposed reservoir construction. The impact of the existing Lake Patagonia on the Sonoita Creek hydrologic system was demonstrated utilizing this model. High and low flow regimes in Sonoita Creek were analyzed taking into account evaporation and changes in storage parameters to develop an estimate of the availability of ground water in the Rio Rico aquifer. The bases for a predictive stream flow model, based on inputs to and losses from the stream system, were also developed.
W80-06327

WATER AVAILABILITY AND FLOOD HAZARDS IN THE JOHN DAY FOSSIL BEDS NATIONAL MONUMENT, OREGON,
Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 2E.
W80-06354

Group 4A—Control Of Water On The Surface

APPLICATION OF MATHEMATICAL OPTIMIZATION TECHNIQUES IN RESERVOIR DESIGN AND MANAGEMENT STUDIES,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
E. E. Whitlatch, and N. R. Bhaskar.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-222243, Price codes: A13 in paper copy, A01 in microfiche. Water Resources Center, Ohio State University Project Completion Report No. 525X, December 1978. 262 p, 49 Fig, 52 Tab, 58 Ref. OWRT-A-046-OHIO (1).

Descriptors: *Reservoir operation, *Linear programming, Dynamic programming, *Simulation analysis, Water shortage, Safe yield, Regression analysis, Water supply, Flood control, *Optimum development plans, Techniques, Hoover Reservoir, Central Ohio, Linear decision rules, Reservoir sizing, chance-constrained programming, release policies, Loss functions.

Optimal monthly release policies are derived for Hoover Reservoir, Columbus, OH, using chance-constrained linear programming and dynamic programming-regression methodologies. Simulation procedures are used to examine and compare the overall performance of the optimal policies derived by the two methods. Results suggest that for a two-sided quadratic loss function, linear release policies are more optimal. It is also established that the maximum R2 criterion, generally used for model selection, does not exactly produce the best form of a release policy, particularly for nonlinear forms. At target releases at or below the safe yield of the case study reservoir, and for a one-sided quadratic loss function, the standard policy is optimal. At higher targets, nonlinear policies give better performance than the standard policy. Other observations are made concerning the performance of the two optimizations approached in a real case study.
W80-06410

NETWORK FLOW OPTIMIZATION FOR WATER RESOURCES PLANNING WITH UNCERTAINTIES IN SUPPLY AND DEMAND,
Texas Univ. at Austin. Dept. of Mechanical Engineering.
P. A. Jensen, H. W. Chu, and D. D. Cochard.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-221161, Price code: A07 in paper copy, A01 in microfiche. Center for Research in Water Resources, University of Texas Technical Completion Report, CRWR-172, July 1980. 137 p, 35 Fig, 4 Tab, 64 Ref. OWRT-A-046-TEX (1), 14-34-0001-9046, 0146.

Descriptors: *Short-term planning, *Networks, *Reservoir operation, *Flow control, *Optimization, *Stochastic modeling, Planning, Decision making, Management, Water distribution(Applied), Flow, Water management(Applied), Operation, Water storage, Operations research, Linear programming, Mathematical models, Systems analysis, Economics, Water resources, Water supply, Water demand, Network flow programming, Uncertainty.

Water resource planning for multireservoir water distribution systems often requires decision making in the presence of uncertain predictions of water supplies and demands. To aid the decision maker, mathematical optimization procedures have been applied to deterministic models of multiperiod water resource systems. The answers obtained, however, are not useful because an optimization procedure can look ahead into the future in its search for an optimum policy. Unfortunately, in the real situation, this predictive capacity is not available. This research attempts to remedy this situation by incorporating uncertainty explicitly into the models. Three different approaches are presented. The first constructs a deterministic equivalent which assigns uncertainty to the various components of the system and then prescribes targets for their operation. The second solves the problem of two stage decision making with recourse. The third provides a multiperiod model and uses stochastic dynamic programming in a way that should yield greater computational efficiency in finding a solution. All three approache utilize network models and the efficient computational methods applicable to networks that have recently become available.
W80-06436

4B. Groundwater Management

PUBLIC POLICY FOR THE MANAGEMENT OF GROUNDWATER IN THE COASTAL PLAIN OF NORTH CAROLINA,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
J. K. Sherwani.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-211287, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Institute, University of North Carolina, Raleigh, Report No 158, July 1980, 63 p, 6 Fig, 24 Tab. OWRT A-082-NC(1). 14-34-0001-6034.

Descriptors: *Groundwater, Groundwater management, Water quality, Supply, Groundwater movement, Aquifers, *Groundwater resources, *Aquifer management, Saline water intrusion, Artificial recharge, Evaluation, Coastal aquifers, *Phosphate mining, Drawdown, *Coastal Plains of North Carolina.

A Capacity Use Area was established in the Coastal Plain of North Carolina for the purpose of management of groundwater resources. However, no effective water management measures have yet been attempted. The need for management is emphasized by the fact that in some parts of the region, the aquifer system is reaching its production potential to permit open-pit mining for phosphate ore. The areas of large concentrated withdrawals and extensive lowering of the potentiometric surface have created conditions for possible water quality deterioration. The projections of water needs for municipal, industrial, and agricultural uses to the year 2000 are developed. As phosphate mining constitutes the largest use, a detailed analysis of alternative arrangements of dewatering wells is conducted. Supplemental irrigation requirements are considered in some detail. Groundwater quality is of major importance in the optimal management of the aquifer system on a regional basis. The most important problems that are likely to result are (1) upconing of brackish water, (2) lateral flow from lenses of poor quality water within the aquifer, and (3) downward movement of estuarine water. These are examined. The role of artificial recharge in aquifer management is explored. The value of water in alternate uses is estimated. The interdependence of water users and external costs imposed on others is considered. The need for the creation of a water district for the management of the aquifer system on a regional basis and the role of permits and user charges are outlined.
W80-06221

GROUNDWATER LAW IN VERMONT: PLANNING FOR UNCERTAINTY, PLURALISM AND CONFLICT,
Vermont Law School, Royalton. Environmental Law Center.
For primary bibliographic entry see Field 6E.
W80-06260

OPTIMAL USE OF GROUNDWATER AND SURFACE WATER TO REDUCE LAND SUBSIDENCE,
Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
G. E. Acosta-Gonzalez, and D. L. Reddell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-220338, Price codes: A07 in paper copy, A01 in microfiche. Texas Water Resources Institute, Texas A&M University, Technical Report No 103, August 1980. 228 p, 17 Fig, 26 Tab, 69 Ref, 10 Append. OWRT-A-038-TEX (1), 14-34-0001-7091,7092,8046,9046.

Descriptors: *Land subsidence, *Drawdown, *Aquifer management, *Model studies, Surface-groundwater relationships, Texas Gulf Coast, Houston-Galveston area(TX), Optimum development plans, *Optimization model.

An optimization model was developed to allocate surface and groundwater resources under various water management policies which might be implemented to control land-surface subsidence. This model allocated the water resources of a region so that the overall cost of water development and land-surface subsidence was minimized. To use this model, a hydrologic model was developed to predict the piezometric heads in sand and clay layers caused by groundwater pumpage. A compaction, or subsidence model, used the resulting piezometric heads from the hydrologic model to predict land-surface subsidence. A linear programming model was then developed to optimally allocate ground and surface water resources within a region so that the cost of water and land subsidence was minimized. Parametric analysis was used to study the effects on the optimal allocation when the coefficients in the objective function or the right hand side of the constraints were changed individually or simultaneously. This procedure allowed a systematic analysis to be made of the changes in the optimal solution caused by increased water cost, increased water demands, the volume of the surface water reserve, and the groundwater availability throughout the region.
W80-06331

PROJECTED EFFECTS OF INTERMITTENT CHANGES IN WITHDRAWAL OF WATER FROM THE ARIKAREE AQUIFER NEAR WHEATLAND, SOUTHEASTERN WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 2A.
W80-06358

WATER TABLE IN THE HIGH PLAINS AQUIFER IN 1978 IN PARTS OF COLORADO, KANSAS, NEBRASKA, NEW MEXICO, OKLAHOMA, SOUTH DAKOTA, TEXAS, AND WYOMING,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W80-06361

DEPTH TO THE WATER TABLE IN THE COLORADO SPRINGS--CASTLE ROCK AREA, FRONT RANGE URBAN CORRIDOR, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W80-06363

TO EXAMINE EXISTING WATER QUALITY EFFECT ON GROWTH OF HORTICULTURE PLANTS,
J. E. Klett, and M. Enevoldsen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-222219, Price codes: A02 in paper copy, A01 in microfiche. Completion Report, May 1979. 18 p, 5 Fig, 2 Tab, 10 Ref. OWRT-A-064-SDAK (1), 14-0001-7088.

Descriptors: *Irrigation water, *Soil-water-plant relationships, *Salinity, *Toxicity, *Greenhouses, Crop response, Growth rates, Size, Productivity, Irrigation effects, South Dakota, Water quality, Sodium, Chlorides, Soil contamination effects, Automation, Water injury, Plant physiology, Soil chemical properties, Chrysanthemums.

The effect of the high soluble salt and high sodium concentrations found in South Dakota on horticultural enterprises, especially greenhouses, was investigated. Chrysanthemum plants were grown in an aerated water culture and then with an automatic surface irrigation technique to eliminate pH fluctuations. Chrysanthemums were chosen because of the severe toxicity symptoms they readily exhibit. Sodium was introduced into the growth media by the addition of NaCl, Na2CO3, and NaHCO3 in a 3-2-1 ratio. Plants grown in water culture showed

sodium toxicity around 600 ppm and plants grown in sand culture exhibited toxicity symptoms at about 400 ppm Na and death at about 1200 ppm. The chloride levels in the water tested gave no major differences visually or in dry matter accumulation. The results are only applicable to chrysanthemums and future work will investigate the addition of calcium sulfate to the soil or irrigation water to displace the sodium from the cation exchange complex and give better water quality. (Sidney-IPA).
W80-06366

EFFECT OF IRRIGATION MANAGEMENT AND WATER TABLE DEPTH ON WATER AND SALT DISTRIBUTION AS PREDICTED BY A COMPUTER SIMULATION MODEL,
Department of Agricultural Technical Services, Stellenbosch (South Africa). Winter Rainfall Region.
P. C. Van Rooyen, and J. H. Moolman.
Water SA (Pretoria), Vol 6, No 2, p 66-78, April 1980. 10 Fig, 13 Tab, 6 Ref.

Descriptors: *Computer models, *Irrigation, *Salinity, *Irrigation effects, Computer programs, Irrigation efficiency, Soil chemical properties, Soil physical properties, Soil types, Irrigation water, Saline soils, Frequency, Time, Penetration, Saturation, Distribution, Profiles, Research equipment, Soil investigations, *South Africa.

A computer simulation model for the prediction of detailed return flow salinity developed by the United States Bureau of Reclamation (USBR) was applied to two water table depths and two frequencies of flood irrigation. The effects of a single flood irrigation at the beginning of the season on water and salt distribution and movement were also investigated. Many irrigation areas in South Africa have high salt concentrations in the root zone caused by poor irrigation management and these studies will help prevent salinity problems. An Oakleaf soil form (Jozini series) prevalent in irrigated areas was chosen for the simulation studies. The soil physical characteristics and chemistry are well established and simulations were obtained using an unsaturated flow program and an unsaturated chemistry program. Heavy application of 180 mm irrigation at the beginning of the irrigation season gave deeper water penetration throughout the season and slightly lower ultimate total salt loads than high frequency irrigation. Short and long irrigation frequencies did not exhibit deep water penetration and gave higher salinity profiles. A shallow (2 m) water table can cause a deterimental salt distribution. (Sidney-IPA).
W80-06370

THE ROLE OF GROUNDWATER RECHARGE IN WASTEWATER REUSE: ISRAEL'S DAN REGION PROJECT,
Tahal Consulting Engineers Ltd., Tel-Aviv (Israel).
E. Idelovitch, R. Terkeltoub, and M. Michail.
American Water Works Association Journal, Vol 72, No 7, p 391-400, July 1980. 13 Fig, 3 Tab, 10 Ref.

Descriptors: *Groundwater recharge, *Water reuse, *Water spreading, *Pit recharge, Tertiary treatment, Sewage effluents, Aquifers, Municipal wastes, Reclamation, Water supply, Groundwater resources, Observation wells, Water wells, Chlorides, Water storage, Microbial degradation, *Israel.

Groundwater recharge with tertiary effluent via spreading basins is practiced in the Dan region project for indirect reuse of municipal wastewater from the Tel Aviv metropolitan area. A comprehensive monitoring program accompanies the full-scale recharge operation. The chloride ion is a reliable tracer of the recharged effluent in the aquifer. The effluent quality is substantially improved by passage through both the unsaturated zone and the calcareous sandstone aquifer, particularly with respect to organic matter, phosphorus, chemical stability, sodium adsorption ratio, and several trace elements. In addition to effluent treatment, groundwater recharge provides seasonal and multiannual storage, offers economic as well as psychological benefits, and enhances the reliability of the reclamation system. (Visocky-ISWS).
W80-06380

GROUNDWATER RECHARGE OPERATIONS IN CALIFORNIA,
California State Water Resources Control Board, Sacramento.
T. Asano, and K. L. Wassermann.
American Water Works Association Journal, Vol 72, No 7, p 380-385, July 1980. 2 Fig, 2 Tab, 11 Ref.

Descriptors: *California, *Groundwater recharge, *Water spreading, *Water reuse, Reclamation, Water levels, Groundwater resources, Saline water intrusion, Water storage, Municipal wastes, Sewage treatment, Pumping, Water supply, Microbial degradation, California Water Code.

Five major groundwater recharge operations in the state of California use reclaimed water. They reclaimed approximately 26,000 acre-ft or 14.2% of the total reclaimed water used in 1977; they served to replenish the groundwater supply (three operations) and to prevent saltwater intrusion into groundwater aquifers (two operations). Increased recharge is expected at all five sites in the future, and a tenfold increase in the statewide volume for groundwater recharge with reclaimed water has been projected. However, concerns for potential long-term health effects of reclaimed water in groundwater have prevented expansion of present recharge operations and discouraged new projects. The advantage of groundwater recharge by surface spreading is that underground water supplies may be replenished in the vicinity of metropolitan and agricultural areas where groundwater overdraft is severe, with the added benefits of filtering effect of soils and transporting facilities of aquifers. Groundwater recharge by injection is practiced, in most cases, where the groundwater is deep or where the topography or existing land use such as urban areas makes basin recharge impractical or too expensive. This method of groundwater recharge is particularly effective in creating freshwater barriers in coastal aquifers against intrusion of saltwater from the sea. (Visocky-ISWS).
W80-06381

CASE STUDY ON WATERLOGGING AND SALINITY PROBLEMS IN PAKISTAN,
National Engineering Services, Lahore (Pakistan).
S. M. H. Bakhari.
Water Supply & Management, Vol 4, No 3, p 171-192, May 1980. 4 Tab, 12 Ref.

Descriptors: *Salinity, *Drainage, *Pakistan, *Irrigation, Dewatering wells, *Land reclamation, Water table, Design, Operation and maintenance, Planning, Water management(Applied), Social aspects, Economics, Programs, Data collections, Financing, Saturated soils, *Waterlogging.

Pakistan has the largest gravity flow irrigation network in the world but its economic output per unit of water diverted at the source is one of the lowest for any country. This is due to a variety of problems not the least of which are waterlogging and salinity. Special efforts to evaluate and remedy these two problems over the last three decades are described. A recent field survey revealed that vertical drainage using tubewells under the Salinity Control and Reclamation Program (SCARP) has partially reclaimed salt affected areas but has failed to lower the water table. An evaluation of SCARP revealed conceptual errors, faulty design, construction, and maintenance of tubewells and distribution systems, poor operation and management practices, and lack of farmer's participation. A revised strategy was developed to make the best use of projects already executed and to modify data collection, planning, designing and implementation of future projects based on the availability of financial resources. A multidisciplinary approach to planning, evaluation and decision-making assisted by appropriate mathematical models, systems analysis and decision theories was recommended for selecting the most appropriate project design for land reclamation and drainage programs. Twenty other recommendations are presented for future course of action. (Purdin-NWWA).
W80-06412

WATER QUALITY EFFECTS ASSOCIATED WITH IRRIGATION,
Kansas Water Resources Board, Topeka.
R. G. Balsters, and C. Anderson.
Kansas Water News, Vol 22, No 1 and 2, p 14-22, Winter, 1979. 2 Fig, 2 Tab.

Descriptors: *Water quality, *Groundwater, *Irrigation water, *Kansas, Water pollution, Return flow, Water chemistry, Environmental effects, Salinity, Fertilizers, Pesticides, Ions.

Ground water is used to irrigate 95% of 3 million acres of Kansas cropland. Irrigation may increase salt concentration and add sediments, fertilizers, and pesticides to runoff and return water making the water unsuitable for agricultural, industrial, and domestic uses. In addition, overpumping an aquifer may cause salt water intrusion from an adjacent brine aquifer. The geochemistry of the various water quality constituents in irrigation water is discussed. Factors that alter irrigation water quality are evapotranspiration, erosion, ion exchange, leaching, filtration, consumptive use by crops, chemical composition of the soil, irrigation methods, crop variety, and the initial quality and quantity of the irrigation water. Thus, degradation of irrigation water is highly variable and site specific. (Purdin-NWWA).
W80-06420

GROUND WATER RESOURCE MANAGEMENT IN KANSAS,
Kansas Ground Water Management Districts Association, Topeka.
R. F. Sloan.
Kansas Water News, Vol 22, No 1 and 2, p 2-6, 23, Winter, 1979.

Descriptors: *Aquifer management, *Groundwater resources, *Irrigation effects, *Kansas, *Water districts, Local government, Water quality, Water levels, Decision making, Cost sharing, Planning, Programs, Scheduling, Irrigation districts, Irrigation practices, Irrigation programs, Weather modification, Artificial recharge.

The Kansas Ground Water Management District act of 1972 encouraged the formation of local ground water management districts each with its own unique hydrogeologic characteristics. Local decision making would be supported by state guidance, technical expertise and financial assistance to obtain the optimum product of most benefits/least costs. A brief synopsis of five Kansas ground water management districts is given. Ground water quantity and quality problems have given rise to associated management strategies suitable for each district. This has resulted in stabilization of ground water levels or decelerating drawdown to acceptable rates, monitoring of salt water intrusion, irrigation scheduling for optimum ground water use, and augmenting available ground water supplies through weather modification and artificial recharge. (Purdin-NWWA).
W80-06421

4C. Effects On Water Of Man's Non-Water Activities

SIMULATION OF EFFECTS OF URBANIZATION ON STORMWATER RUNOFF AND QUALITY,
Tennessee Univ., Knoxville. Dept. of Civil Engineering.
D. E. Overton, W. L. Troxler, and E. C. Crosby.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-211253, Price codes: A04 in paper copy, A01 in microfiche. Tennessee Water Resources Research Center, University of Tennessee Research Report No 74, December 1, 1979. 58 p. OWRT A-046-TENN(4).

Descriptors: *Model studies, *Urbanization, *Effects, *Storm runoff, *Water quality, Watershed hydrology, Mathematical models, Simulation anal-

ysis, *Stormwater simulation, Nonpoint source pollution, *Urban runoff.

A parametric model for simulating stormwater hydrographs and quality has been developed. The model, TENN-I, is based upon the analysis of more than 400 storms in both urban and rural watersheds, and has the capability of simulating runoff before and after urbanization. TENN-I offers an alternative to deterministic model simulation in that no assumption need be made as to the extent of surface runoff, the model has both an analysis and simulation phase and the model coefficients have been determined by optimization of numerous storms from a variety of land uses. TENN-I would be most reliable in the Appalachian region.
W80-06223

LAND USE, LAND COVER, AND DRAINAGE ON THE ALBEMARLE-PAMLICO PENINSULA, EASTERN NORTH CAROLINA, 1974,
Geological Survey, Raleigh, NC. Water Resources Div.
C. C. Daniel, III.
Geological Survey Water-Resources Investigations 78-134 (open-file report), 1978. 2 Sheets, 5 Fig, 7 Ref.

Descriptors: *Land use, *Land classification, *Land clearing, *North Carolina, *Environmental effects, Surface drainage, Regional analysis, Hydrology, Wetlands, Forests, Farms, Canals, Ditches, Water quality, Maps, Albemarle-Pamlico Peninsula(NC), *Eastern North Carolina, Drainage effects.

A land use, land cover, and drainage map of the 2,000-square-mile Albermarle-Pamlico peninsula of eastern North Carolina has been prepared, at a scale of 1:125,000, as part of a larger study of the effects of large-scale land clearing on regional hydrology. The peninsula includes the most extensive area of wetland in North Carolina and one of the largest in the country. In recent years the pace of land clearing on the peninsula has accelerated as land is being converted from forest, swamp, and brushland to agricultural use. Conversion of swamps to intensive farming operations requires profound changes in the landscape. Vegetation is uprooted and burned and ditches and canals are dug to remove excess water. What is the impact of these changes on ground-water supplies and on the streams and surrounding coastal waters which receive the runoff This map will aid in answering these and similar questions that have arisen about the patterns of land use and the artificial drainage system that removes excess water from the land. By showing both land use and drainage, this map can be used to identify those areas where water-related problems may occur and help assess the nature and causes of these problems. The map covers the entire area east of the Suffolk Scarp, an area of about 2,000 square miles, for the year 1974 using data from 1974-76. Land use and land cover were compiled and modified from the U.S. Geological Survey's Rocky Mount and Manteo LUDA maps. Additional information came from U.S. Geological Survey orthophotoquads, Landsat imagery, and field checking. Drainage was mapped from orthophotoquads, some field inspection, and 7-1/2 minute topographic quadrangle maps. (USGS).
W80-06247

EVALUATION OF THE IMPACT OF TEXAS LIGNITE DEVELOPMENT ON TEXAS WATER RESOURCES,
Texas A and M Univ., College Station. Dept. of Geology.
C. C. Mathewson, and C. L. Cason.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80 220635. 163. A08A01. Texas Water Resources Institute, Texas A & M University Technical Completion Report, July 1980. 144 p, 34 fig, 20tab, 318 ref. 14-34-0001-7091,7092.

Descriptors: *Coal mine waste, *Environmental effects, *Water resources, *Texas, Coals, Lignite, Surface waters, Groundwater, Hydrology, Soils, Vegetation, Water demand, Mining requirements. Fuel shortages and resultant rising fuel costs as well as federal policies prompting energy independence have served to encourage power companies to exploit available lignite deposits of the western states as a viable fuel source. Large reserves of lignite found in a northeasterly trending belt through Texas have been only partially tapped. To develop this natural resource, large volumes of water will be required for mining, handling, processing, cooling, power generation, and land reclamation. Throughout the Texas lignite belt, physical characteristics vary widely depending mainly upon the amount of water present in any form. Research into the potential impact of the development of the Texas lignite resources on both the surface and groundwater resources of Texas has produced three separate areas within the lignite belt which have varying capabilities of supporting lignite development. The northeastern section of the lignite belt has sufficient surface water resources and backup groundwater resources to allow extensive development of lignite. The central section will support mining and development, but care must be taken to conserve and regulate water use. The southwestern section of the lignite belt does not possess sufficient ground or surface water resources for much, if any, lignite development. The most water thrifty methods of production would have to be employed for even limited development.
W80-06261

A COMPILATION OF HYDROLOGIC DATA BEFORE AND DURING HIGHWAY CONSTRUCTION IN PARTS OF TIJERAS CANYON, NEW MEXICO, 1972-1978,
Geological Survey, Albuquerque, NM, Water Resources Div.
J. D. Hudson.
Available from OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, Paper copy $10.25, Microfiche $3.50. Geological Survey open-file report 80-332, March 1980. 80 p, 5 Fig, 8 Tab.

Descriptors: *Baseline studies, *Hydrologic data, *Road construction, *Surface waters, *Groundwater, New Mexico, Basic data collections, Water wells, Springs, Water level fluctuations, *Tijeras Canyon(NM), *Bernalillo County(NM).

Tijeras Canyon extends about 15 miles eastward from the eastern edge of Albuquerque, NM. The canyon is the site of a new part of Interstate Highway 40. The purpose of this report is to present surface- and ground-water data collected prior to and during highway construction. Well and spring data from near the construction site are tabulated, and spring inflow in Tijeras Creek is shown. Water levels in selected wells are shown in hydrographs based on monthly measurements and continuous water level measurements. This report includes all of the data in a similar previous report (U.S. Geological Survey Open-file report 78-238), plus approximately one additional year of data. (USGS).
W80-06347

4D. Watershed Protection

CHANNEL EROSION AND SEDIMENT TRANSPORT IN PHEASANT BRANCH BASIN NEAR MIDDLETON, WISCONSIN--A PRELIMINARY REPORT,
Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 2J.
W80-06241

WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

MOVEMENT OF NITROGEN AND CARBON FROM A SEPTIC SYSTEM DRAINFIELD,
Connecticut Agricultural Experiment Station, New Haven.
For primary bibliographic entry see Field 5B.
W80-06212

METAL CONCENTRATIONS IN MARINE SEDIMENTS FROM LEBANON,
ARABCONSULT, Beirut (Lebanon).
J. G. Shiber.
Water, Air, and Soil Pollution, Vol 13, No 1, p 35-43, March 1980. 1 Fig, 4 Tab, 33 Ref.

Descriptors: *Heavy metals, *Sediments, *Coasts, Sampling, Surveys, Pollutants, Water pollution, Path of pollutants, Water pollution sources, Lead, Cadmium, Copper, Nickel, Iron, Zinc, Chromium, Manganeses, *Lebanon, Marine sediments.

Nearshore shalow marine sediment was collected from 14 points along the Lebanese coast and anayzed for heavy metals. The samples consisting of medium to fine sand (those from Khalde, Rmeileh, and Sidon) had generally lower metal concentrations than those made up of very coarse to coarse sand (Tabarja, Beirut, Adloun), fine to very fine sand (Beirut), and very fine sand to coarse silt (Nahr Ibrahim Village). The sediments that had the highest Pb, Zn, and Mn were from Beirut and Adloun. Those with the highest Fe concentrations came from Beirut and Nahr Ibrahim Village, and the highest Cu occurred in sediments collected from Beirut and Tabarja. The metal levels found did not seem to reflect abnormal contamination in the areas sampled. More extensive work was recommended. (Sims-ISWS)
W80-06213

INVESTIGATION OF LAKE ONTARIO WATER QUALITY NEAR PORT GRANBY RADIOACTIVE WASTE MANAGEMENT SITE,
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 5B.
W80-06214

QUALITY OF TIGRIS RIVER PASSING THROUGH BAGHDAD FOR IRRIGATION,
Environmental Pollution Research Centre, Baghdad (Iraq).
S. M. Mutlak, B. M. Salih, and S. J. Tawfiq.
Water, Air, and Soil Pollution, Vol 13, No 1, p 9-16, March 1980. 1 Fig, 2 Tab, 7 Ref.

Descriptors: *Water quality, *Rivers, *Irrigation, Sampling, Turbidity, Temperature, Chemicals, Metals, Heavy metals, Water pollution, Pollutants, Dissolved solids, Hardness(Water), Hydrogen ion concentration, Cities, Waste disposal, Path of pollutants, *Iraq, *Tigris River(Iraq).

The effect of Baghdad city on the water quality of the Tigris River was studied from April 1977 tp March 1978. The chemical and physical characteristics of the water that are necessary in judging the quality of water for irrigation was studied. It was found that Baghdad was responsible for increasing the water salinity from 390 to 443 mg/l. Total hardness and turbidity were increased when the river passed through Badhdad. The increase in the total hardness was mostly due to the increase in Mg concentration. the results also suggested that there should be no problem from the heavy metals or inorganic N in this water when used for irrigation. The Tigris River water in Baghdad was classified as class C sub 2 S sub 1; that is water of second class with regard to salinity and first class with regard to sodicity. (Sims-ISWS)
W80-06215

METALLIC CONTENTS IN WATER AND SEDIMENS OF LAKE NAINI TAL, INDIA,
Kumaun Univ., Naini Tal (India). MAB/DST Lakes Project.
J. Pande, and S. M. Das.
Water, Air, and Soil Pollution, Vol 13, No 1, p3-7, March 1980. 1 Fig, 2 Tab, 10 Ref.

Descriptors: *Water pollution, *Pollutants, *Metals, *Lakes, Water chemicals, Sediments, Copper, Cobalt, Zinc, Lead, Manganese, Sodium,

Potassium, Calcium, Sampling, Chemical analysis, Lithium.

Copper, Co, Zn, Pb, Mn, Li, Na, K, and Ca were analyzed by atomic absorption spectrophotometry in four stations around Lake Naini Tal and one station at mid-lake. The samples of water in each station (except station V) were taken from both the surface and the bottom. The values for the metals were expressed in m/l which show wide variations at different stations. The bottom sediments from the stations around the lake were also analyzed, the values being expressed in mg/k. These values were comparatiely much higher than those in the water, while wide variations were shown to occur in the bottom sedimens from one station to another. Explanations for some of the variations were given in the paper. (Sims-ISWS)
W80-06216

RADIOISOTOPE DETERMINATION OF UPTAKE OF TOXIC METALS IN ORGANIC-RICH BOTTOM SEDIMENT,
Michigan State Univ., East Lansing. Dept. of Geology.
F. L. Hesse, and D. F. Sibley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-211170, Price codes: A06 in paper copy, A01 in microfiche. Institute of Water Research, Michigan State University, Project Completion Report, April, 1980. 107 p, 10 Fig, 4 Tab, 4 Append. OWRT B-036-MICH(2), 14-31-0001-5084.

Descriptors: *Radioisotopes, *Toxins, *Heavy metals, *Bottom sediments, *Organic-rich sediments, Mercury, Copper, Cobalt, Cadmium, Zinc, Displacive effects, Ions, Uptake-competition experiments.

In the uptake-competition experiments 100 grams of organic-rich bottom sediment were placed in liter beakers and covered with water. Radiotracers of mercury-137, copper-64, cobalt-60, cadmium-115 and zinc 69m were added and the uptake by the dediment monitored with liquid scintillation counting. During these experimens conradioactive competing metallic ions were added to some beakers to determine possible displacive effects. In a total uptake procedure, using the aforementioned radioisotopes, samples were taken through Millipore filters (.45 micron) to determine uptake by sediment. No displacive effects were noted. Results indicate that heavy metal ions react rapidly with substances in the overlying water and slowly settle onto the water-sediment interface as floc. During these experimens slight aqitations of the sediment were shown to place more metal into the overlying water, probably in the form of slightly denser than water floc. The uptake-competition experimens show uptaks in varying percentages. Some loss of metal ions to the container walls was found. The percentage loss was greatest for mercury, followed by cobalt, zinc, cadmium and copper.
W80-06218

URBAN STORMWATER POLLUTANT LOADINGS,
Union Coll., Schenectady, NY. Dept. of Civil Engineering.
T. K. Jewell, D. D. Adrian, and F. A. DiGiano.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-211154, Price codes: A09 in paper copy, A01 in microfiche. Water Resources Research Center, University of Massachusetts, Amherst Publication No 113, 1980. 186 p, 9 Fig, 28 Tab, 83 Ref. OWRT A-095-MASS(2). 14-34-0001-7046.

Descriptors: *Stormwater management models, *Pollutant loadings, Forecasting, *Urban runoff, Storm water, *Storm runoff, Rainfall-runoff relationships, *Model studies, Urban drainage, Water pollution, Total solids, Loading rates, Land use.

The runoff quality portions of existing stormwater management models have not fostered confidence in their predictive capabilities. Lack of confidence has been engendered by the use of unverified predictive algorithms and by the variability of measured stormwater pollution data. This study was designed to produce improved stormwater pollutant washoff prediction techniques which would be verifiable and would take into account data variability. Available storm event pollution data is examined and the best of the data catalogued into a data storage and retrieval system. The catalogued data includes 261 storm events from 26 basins in 12 geographical areas. The data file is used to show that it is not possible to derive general pollutant washoff functions containing a given set of independent variables that would give reasonable results for most areas. This is true for either storm event total loadings or instantaneous fluxes. It is concluded that data should be gathered for each basin to be studied. A methodology was developed that permits the use of this data to predict stormwater pollution washoff for individual watersheds. It includes suggested trial formulations and guidelines for applying linear and intrinsically linear multiple regression analyses to pick the best model for predicting the washoff of each pollutant. This methodology represents a distinct improvement over existing stormwater quality predictive techniques. Researchers will not be able to predict stormwater pollutant loadings with a measurable degree of certainty.
W80-06222

RESORCINOL AS A REAGENT FOR ZINC,
Auburn Univ., AL. Dept. of Chemistry.
R. H. Dinius, and J. M. Baker.
Microchemical Journal, Vol 25, p 209-218, 1980. 4 Fig, 1 Tab, 11 Ref. OWRT A-036-ALA(2).

Descriptors: *Water analysis, *Zinc, *Chemical analysis, *Spectrophotometry, *Colorimetry, Trace elements, Color reactions, Oxidation, Chemical reactions, Sampling, Inorganic compounds, Variability, Graphical analysis, Resorcinol, Reagent.

The use of the zinc-ion-catalyzed autoxidation or hydrogen peroxide oxidation of resorcinol (1,3-dihydroxybenzene) for zinc concentration analysis was investigated at various reagent concentrations, pH, and reaction times. The concentration of zinc was determined by correlation with the absorbance of the products resulting from zinc-catalyzed autoxidation using spectrophotometric methods. The autoxidation reaction was found to be pH dependent (optimum pH is 10) and the ammonia buffer system for the metal-ion catalyzed reaction was the most effective. The background effect of noncatalytic autoxidation and the effect of closed containers were studied. The reaction time was approximately 1 hour and a relative average deviation of 10% over the concentration range of 0.9 ppm to about 8 ppm was found. The resorcinol oxidation reaction is a convenient and inexpensive reagent for zinc analysis. (Sidney-IPA)
W80-06230

DETERMINATION OF SELECTED ANIONS IN WATER BY ION CHROMATOGRAPHY,
Geological Survey, Lakewood, CO. Water Resources Div.
M. J. Fishman, and G. Pyen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80 111941, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 79-101, September 1979. 30 p, 2 Fig, 12 Tab, 2 Ref.

Descriptors: *Chromatography, *Anions, *Precipitation(atmospheric), *Surface waters, *Chemical analysis, Analytical techniques, Water analysis, Bromides, Chlorides, Fluorides, Nitrates, Nitrites, Phosphates, Sulfates, Sampling, Water quality, *Ion chromatography.

Ion chromatography is a rapid, sensitive, precise, and accurate method for the determination of major anions in rainwater and surface waters. Simultaneous analyses of a single sample for bromide, chloride, fluoride, nitrate, nitrite, orthophosphate, and sulfate require approximately 20 minutes to obtain a chromatogram. Minimum detection limits range from 0.01 mg/L for fluoride to 0.20 mg/L for chloride and sulfate. Relative standard deviations were less than 9% for all anions except nitrite in Standard Reference Water Samples. Only one reference sample contained nitrite and its concentration was near the minimum level of detection. Similar precision was found for chloride, nitrate, and sulfate at concentrations less than 5 mg/L in rainfall samples. Precision for fluoride ranged from 12 to 22%, but is attributed to the low concentrations in these samples. The other anions were not detected. To determine accuracy of results, several samples were spiked with known concentrations of fluoride, chloride, nitrate, and sulfate; recoveries ranged from 96 to 103%. Known amounts of bromide and phosphate were added, separately, to several other waters, which contained bromide or phosphate. Recovery of added bromide and phosphate ranged from approximately 95 to 104%. No recovery data were obtained for nitrite. Chloride, nitrate, nitrite, orthophosphate, and sulfate, in several samples, were also determined independently by automated colorimetric procedures. An automated ion-selective electrode method was used to determine fluoride. Results are in agreement with results obtained by ion chromatography. (USGS).
W80-06244

THE TEMPORAL VARIATIONS OF LEAD CONCENTRATION IN A FRESHWATER LAKE,
California State Coll. Stanislaus, Turlock. Dept. of Chemistry.
J. E. Byrd, and M. J. Perona.
Water, Air, and Soil Pollution, Vol 13, No 2, p 207-220, June 1910. 9 Fig, 5 Tab, 13 Ref. OWRT A-064-CAL(2).

Descriptors: *Lead. *Lakes, *Lake sediments, *California, Sampling, Chemical analysis, Pollutants, Pollutant identification, Water chemistry, Water pollution, Water pollution sources, Boats, Temporal distribution, Variability, Spatial distribution, Inflow, Discharge(Water), Mathematical models, Model studies, Limnology.

The temporal and spatial variations in the Pb concentration of a freshwater recreational lake were determined, and the results compared with daily records of lake volume, residence time, and number of boats launched. In addition, laboratory studies were carried out to establish the influence of sediment-water interactions on the Pb concentration of the lake water. The variation in the Pb concentration in the main body of the lake was found to correlate with the lake volume. This fact, together with the laboratory studies and calculations based on a plug flow model, suggests that sediment-water interactions are significant in controlling the Pb concentration in main body of the lake. On the other hand, boating was found to be imporant in controlling the Pb concentration in the boat dock area. The water in this area is subjected to both poor mixing and heavy boat traffic. (Sims-ISWS)
W80-06253

OXYGEN TRANSPORT IN SALMON SPAWNING GRAVELS,
Alaska Univ., Fairbanks. Inst. of Water Resources.
R. A. Johnson.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, p, 155-162, 1980. 3 Fig, 2 Tab, 21 Ref. OWRT B-039-ALAS(1), 14-34-0001-8057.

Descriptors: *Gravel *Oxygen, *Salmonids, *Spawning, Salmon, Sediment transport, Water chemistry, Dissolved oxygen, Flow rates, Fish management, Fish eggs, Bottom sediments, Particle size, Mathematical models.

The importance of understanding transport characteristics of flow through gravel media is discussed from the viewpoint of salmonid enhancement programs. A summary of the important features of the incubation process with respect to mass transport is provided along with appliable theories describing flow through porous media. Data obtained from experiments described herein are used to assess the accuracy of existing correlations for predicting pressure drops across gravel substrates. It is found that available hydraulic relations can be used to predict flow velocity magnitudes in gravel media with an accuracy of + or - 50% over a

twofold range of flow rates, providing one measurement of head loss is available at one flow rate. An adaptation of the Carman-Kozeny equation is found to be suitable for calculating the influence of fines on permeability. The importance of air entrapment on flow resistance is confirmed experimentally and modeled using available correlations. Lastly, the applications of these results for calculating oxygen transport to incubating salmon eggs and minimum water flows in hatcheries are discussed. (Deal-EIS)
W80-06257

NUTRIENT MODELS FOR ENGINEERING MANAGEMENT OF PAMLICO ESTUARY, NORTH CAROLINA,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
D. T. Lauria, and C. R. O'Melia.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80 220585, Price codes: A07 in paper copy, A01 in microfiche. Water Resources Research Institute, University of North Carolina, Raleigh, Rpt. No. 146, July 1980. 120 p, 29 Fig, 8 Tab. OWRT B-092-NC(2), 14-34-0001-6105.

Descriptors: *Simulation analysis, *Computer models, Eutrophication, *Nutrients, Winter, Summer, Nitrogen, Phosphorus, *Water quality, Industrial wastes, *Algal control, Water quality predicting, Pamlico Estuary(NC).

Objectives of this research were: to develop predictive models for nutrients and associated water quality parameters in the Pamlico Estuary for use in managing that aquatic system, to calibrate and verify these models using available data, to use the models to simulate or predict water quality in the Pamlico Estuary under different nutrient loadings, and to use the model to evaluate the significance of selected physical, chemical and biological processes in the estuary. Two steady-state, one-dimensional models have been developed and verified. One model, designed for winter conditions, considers phosphorus as the nutrient limiting algal growth during that season. The second model, developed for summer seasons, is based on nitrogen as the limiting nutrient. Simulations using these models indicate that past industrial discharges of phosphorus have had significant effects on water quality in the estuary. Research indicates nitrogen incorporated into algal blooms during a winter season is detained in estuary sediments until the following summer.
W80-06267

COMPARATIVE TOXICITY OF ARSENIC COMPOUNDS AND THEIR ACCUMULATION IN INVERTEBRATES AND FISH,
Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 5B.
W80-06276

SURVIVAL OF HYPOXIC CONDITIONS BY THE POLYCHAETE CIRRIFORMIA TENTACULATA,
Bedford Coll., London (England). Dept. of Zoology.
R. P. Dales, and L. M. Warren.
Journal of the Marine Biological Association of the United Kingdom, Vol 60, p 509-516, 1980. 2 Fig, 2 Tab, 17 Ref.

Descriptors: *Oxygen requirements, *Animal metabolism, *Anaerobic conditions, Animal physiology, Dissolved oxygen, Oxygen sag, Water chemistry, Biochemistry, Amino acids, Benthic fauna, *Polychaetes, *Cirrifomia, *Hemoglobin, *Blood chemistry.

Cirriformia tentaculate was found to survive limited periods without oxygen by a combination of anaerobic metabolism, oxygen storage and reduced metabolic rate. The haemoglobin has an extremely high 02-affinity, a pronounced Bohr shift and functions in 02-transport and storage under conditions of extreme hypoxia. Anaerobic metabolism leads to accumulation of succinate and alanine together with volatile fatty acids which are excreted. The adaptations of C. tentaculate to hypoxic conditions are briefly compared with those of other facultative anaerobes. (Deal-EIS)
W80-06278

TOLERANCE OF INTERTIDAL AMPHIPODS TO FLUCTUATING CONDITIONS OF SALINITY, OXYGEN AND COPPER,
Tasmania Univ., Hobart (Australia). Dept. of Zoology.
D. A. Ritz.
Journal of the Marine Biological Association of the United Kingdom, Vol. 60, p. 489-498, 1980. 4 Fig, 24 Ref.

Descriptors: *Bioassay, *Amphipods, *Copper, *Oxygen, *Salinity, Dissolved Oxygen, Oxygen Requirements, Water Chemistry, Toxicity, Mortality, Metals, Animal Metabolism, Methodology, *Gammarus, Marinogammarus.

Two intertidal amphipods, Gammarus duebeni Liljeborg, a brackish-water species, and Marinogammarus marinus (Leach) a marine form were exposed to fluctuating salinities, simultaneously with periodic oxygen depletion and added copper. In fluctuating salinities with oxygen depletion of the freshwater phase, additional copper did not additively or synergistically increase mortality in M. marinus. The periodic exposure to clean sea water perhaps permitted removal of excess copper. The brackish water species, G. duebeni suffered no mortality under these conditions. Acute mortality to copper in flowing conditions was greater than in static conditions presumably because the copper concentration was continually being depleted in the latter. These results suggest that conventional bioassays using static and constant conditions of environmental factors cannot be used with confidence to predict mortality in estuarine animals. Patterns of oxygen uptake under conditions of decreasing oxygen tension showed that G. duebeni, the brackish water species, was capable of regulation over a wide range of oxygen concentration. M. marinus, the marine species, on the other hand showed no such powers and was clearly a conformer. (Deal-EIS).
W80-06279

GAS-LIQUID CHROMATOGRAPHIC DETERMINATION OF BAYER 73 IN FISH, AQUATIC INVERTEBRATES, MUD, AND WATER,
Fish and Wildlife Service, Warm Springs, GA. Southeastern Fish Control Lab.
C. W. Luhning, P. D. Harman, J. B. Sills, V. K. Dawson, and J. L. Allen.
Journal of the Association of Official Analytical Chemists, Vol 62, No 5, p 1141-1145, 1979. 3 Fig, 1 Tab, 9 Ref.

Descriptors: *Pesticide residues, *Analytical techniques, Gas chromatography, Chemical analysis, Chemical properties, Rainbow trout, Carp, Bass, Aquatic insects, Pesticide kinetics, *Bayer 73, *Tissue analysis, *Lampricides.

A gas-liquid chromatographic (GLC) method is described for determining residues of Bayer 73 (2-aminoethanol salt of 2',5-dichloro-4'-nitrosalicylanilide) in fish muscle, aquatic invertebrates, mud, and water by analyzing for 2-chloro-4-nitroaniline (CNA), a hydrolysis product of Bayer 73. Bayer 73 residues are extracted from fish muscle tissue, invertebrates, and mud with acetone-formic acid, and partitioned from water samples with chloroform. After sample cleanup by solvent and acid-base partitioning, the concentrated extract is hydrolyzed with 2N NaOH and H2O2. The CNA is then partitioned into hexane-ethyl ether 7+3) and determined by electron capture GLC. Average recoveries were 88% for fish, 82% for invertebrates, 82% for mud, and 98% for water at 3 or more fortification levels. (Deal-EIS)
W80-06282

QUALITY OF WATER AND BOTTOM SEDIMENTS IN THE TRINITY RIVER,
Texas Univ. at Arlington. Dept. of Civil Engineering.
S. R. Qasim, A. T. Armstrong, J. Corn, and B. L. Jordan.
Water Resources Bulletin, Vol 16, No 3, p 522-531, June 1980. 2 Fig, 4 Tab, 14 Ref. Army DACW63-76-C-0140.

Descriptors: *Water quality, *Bottom sediments, *Rivers, *Laboratory tests, Sampling, Bioassay, Sediments, Pollutants, Biochemical oxygen demand, Dissolved oxygen, Nitrogen, Phosphorus, Carbon, Heavy metals, Pesticides, Pollutant identification, *Trinity River(TX).

Data were developed to determine the quality of water and bottom sediments in the Trinity River and the mobility of various contaminants when bottom sediments were mixed with the river water under simulated dredging conditions. Thirteen sampling sites were selected. A number of chemical tests including heavy metals and pesticides were conducted on river water, elutriates, and bottom sediments. Static bioassays using Daphnia magna were conducted on river water and elutriates. Results indicated that the river in the upper reach is grossly polluted due to discharge of wastewater effluents from several large treatment plants. High concentrations of nitrogen, phosphorus, organic carbon, COD, heavy metals, and pesticides were found in water and bottom sediments. The concentrations of most of these pollutants exceeded the EPA recommended limits. Elutriation gave no consistent results, perhaps because of release or uptake of contaminants from the sediments. High mortality of D. magna were also recorded in the upper reach of the river. The quality of water and bottom sediments gradually improved in lower reaches. (Sims-ISWS).
W80-06304

SAMPLING FREQUENCY SELECTION FOR REGULATORY WATER QUALITY MONITORING,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
J. C. Loftis, and R. C. Ward.
Water Resources Bulletin, Vol 16, No 3, p 501-507, June 1980. 8 Fig, 2 Tab, 13 Ref. EPA R805759-01-0.

Descriptors: *Water quality, *Monitoring, *Network design, *Statistical models, Mathematical models, Model studies, Sampling, Variability, Statistics, Networks, Pollutants, Dissolved solids, Carbon, Suspended solids, Hardness (Water), Nitrates, Correlation analysis, Time series analysis.

The selection of sampling frequencies in order to achieve reasonably small and uniform confidence interval widths about annual sample means or sample geometric means of water quality constituents was suggested as a rational approach to regulatory monitoring network design. Methods were presented for predicting confidence interval widths at specified sampling frequencies while considering both seasonal variation and serial correlation of the quality time series. Deterministic annual cycles were isolated, and serial dependence structures of the autoregressive, moving average type were identified through time series analysis of historic water quality records. The methods were applied to records for five quality constituents from a nine-station network in Illinois. Confidence interval widths about annual geometric means were computed over a range of sampling frequencies appropriate in regulatory monitoring. Results were compared with those obtained when a less rigorous approach, ignoring seasonal variation and serial correlation was used. For a monthly sampling frequency the error created by ignoring both seasonal variation and serial correlation was approximately 8%. Finally, a simpler technique for evaluating serial correlation effects based on the assumption of AR(1) type dependence was examined. It was suggested that values of the parameter rho sub 1, in the AR(1) model should range from 0.75 to 0.90 for the constituents and region studied. (Sims-ISWS).
W80-06306

IRRIGATION WATER AND SURFACE RUNOFF QUALITY AND QUANTITY IN CARSON VALLEY, NEVADA,

Nevada Univ., Reno. Div. of Plants, Soil, and Water Science.
For primary bibliographic entry see Field 5B.
W80-06308

COMPARISON OF TRACER METHODS AND PREDICTIVE EQUATIONS FOR DETERMINATION STREAM-REAERATION COEFFICIENTS ON THREE SMALL STREAMS IN WISCONSIN,
Geological Survey, Madison, WI, Water Resources Div., and Wisconsin Dept. of Natural Resources, Madison.
R. S. Grant, and S. Skavroneck.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-193642, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water Resources Investigations 80-19, March 1980. 36 p, 12 Fig, 15 Tab, 47 Ref.

Descriptors: *Tracers, *Streams, *Reaeration, *Radioactivity techniques, Wisconsin, Streamflow, Water pollution, Forecasting, Methodology, Estimating equations, Measurement, Oxygenation, Dissolved oxygen, *Reaeration coefficient, *Nonradioactive tracers, Dye tracing.

Four modified nonradioactive-tracer methods and 20 predictive equations for determination of stream-reaeration coefficients in three small Wisconsin streams were compared with the radioactive-tracer method developed by Tsivoglou. Of the four modified-tracer techniques, the propane-area technique, which measures the total weight of propane gas passing stream-sampling stations, yielded the least mean absolute difference of 11.0 percent compared with the radioactive-tracer method. The propane peak concentration, ethylene peak concentration, and ethylene total weight methods gave mean absolute differences of 18, 21, and 26 percent, respectively. The top five ranking predictive equations were as follows: Tsivoglou-Neal with 18 percent mean error, Negulescu-Rojanski with 21 percent, Padden-Gloyna with 23 percent, Thackston-Krenkel with 29 percent, and Bansal with 32 percent. (USGS).
W80-06344

NONPOINT-SOURCE DISCHARGES IN PEQUEA CREEK BASIN, PENNSYLVANIA, 1977,
Geological Survey, Harrisburg, PA, Water Resources Div.
J. R. Ward, and D. A. Eckhardt.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-175656, Price codes: A06 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 79-88, December 1979. 110 p, 20 Fig, 18 Tab, 16 Ref.

Descriptors: *Pennsylvania, *Agricultural watersheds, *Streamflow, *Storm runoff, *Water quality, Sampling, Water analysis, Sediments, Nitrogen, Phosphorus, Pesticides, Path of pollutants, Land use, Hydrographs, Data collections, *Pequea Creek Basin(PA), *Susquehanna River(PA), *Nonpoint sources.

A study of Pequea Creek included measurement of streamflow and collection of water and bottom-material samples during selected base-flow and storm periods from February to December 1977. Samples were analyzed for nitrogen and phosphorus species, suspended sediment, organic carbon, and pesticides. Daily mean constituent concentrations and discharges transported from the basin were computed for a gaging station near the mouth. Intermittent constituent mean concentrations and discharges were computed for storms at the six subbasin sites. The objective of this project was to assess the magnitudes and types of nonpoint discharges that affect the water quality of Pequea Creek. The project included the determination of (1) the total discharges of suspended sediment, nitrogen, and phosphorus from the basin; (2) intermittent storm and base-flow discharges from six subbasin sites of varying size, geology, and land use; (3) the difference in magnitudes of the discharges during base-flow periods and storms; and (4) which variables most affect the transport of these constituents. The yields measured from the Pequea Creek basin for the period February to December 1977 were among the highest measured in the lower Susquehanna River basin. Some preliminary relations between constituents were examined using linear regression techniques on all of the data for each site. Direct runoff transported the majority of the suspended sediment, total phosphorus, and suspended organic carbon from the basin; the other constituents were transported mainly during base flow. (USGS).
W80-06346

STUDIES TO ASSESS THE FATE OF NITROGEN APPLIED TO TURF: PART I,
Cornell Univ., Ithaca, NY. Center for Environmental Research.
K. S. Porter, D. R. Bouldin, S. Pacenka, R. S. Kossack, and C. A. Shoemaker.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-221153, Price code: A03 in paper copy, A01 in microfiche. Research Project Technical Completion Report, August 1980. 16 p, 5 Fig, 3 Tab, 7 Ref, 2 App. OWRT-A-086-NY (1), 14-34-0001-8024.

Descriptors: *Nitrogen cycle, *Turf grasses, *Lawns, *Fertilizers, Effects, Groundwater, Water quality, *Long Island(NY), Nassau County(NY), Suffolk County(NY), Soil organic nitrogen levels.

Ornamental turfgrass occupies between 15 and 20 percent of the one million acres of land in Nassau and Suffolk Counties, NY. Earlier, broad studies of the influence of turf maintenance on groundwater quality pointed out the potential for substantial impact from nitrogenous fertilizers and shortages of data regarding the fates of applied fertilizer. This study was designed to examine accumulation in soil organic matter as one potential fate of applied nitrogen. Based on an age cross-sectional survey of soil organic nitrogen levels, two conclusions were reached. (1) Under Long Island conditions, there is a relatively low capacity for soil organic nitrogen storage. (2) The bulk of this capacity is exhausted after 5 to 10 years. (Pacenka-NY).
W80-06365

AUTOMATED COLORIMETRIC METHOD FOR THE DETERMINATION OF VANADIUM IN FRESH WATER,
Department of Water Affairs (Pretoria) South Africa. Hydrological Research Inst.
A. T. Basson, and P. L. Kempster.
Water SA (Pretoria), Vol 6, No 2, p 88-91, April 1980. 2 Fig, 2 Tab, 9 Ref.

Descriptors: *Water analysis, *Automation, *Colorimetry, Freshwater, Analytical techniques, Instrumentation, Trace elements, Measurement, Laboratory tests, Evaluation, Standards, Performance, Reliability, Variability, Research and development, Equipment, *Vanadium, South Africa.

An automated catalytic method for the determination of vanadium in fresh water samples is described. The gallic acid/persulfate method was used since it is both sensitive and convenient. The apparatus consisted of a Technicon AutoAnalyzer, peristaltic pump, colorimeter, and recorder. Working vanadium standards were prepared daily in the range of 1 to 100 microgram V per cubic decimeter and these were used to set the instrument sensitivity. Samples were analyzed at a rate of 30 per hour and a control sample containing 400 microgram V per cubic decimeter gave a vanadium concentration of 405 microgram V per cubic decimeter. Recovery of vanadium added to water samples gave an average recovery of 104%. Interference tests were also carried out and it was concluded that the automated method has good reproducibility and accuracy and is suitable for batch analysis of a large number of fresh water samples. (Sidney-IPA).
W80-06372

STRONG AND WEAK ACIDS IN SURFACE WATERS OF SOUTHERN NORWAY AND SOUTHWESTERN SCOTLAND,
Norsk Inst. for Vannforskning, Oslo.
A. Henriksen, and H. M. Seip.
Water Research, Vol 14, No 7, p 809-813, 1980. 2 Fig, 4 Tab, 20 Ref.

Descriptors: *Water quality, *Acids, *Lakes, *Surface waters, Streams, On-site investigations, Foreign countries, Hydrogen ion concentration, Data collections, Acid streams, Water pollution, Water sampling, Acidic water, Analysis, Aluminum, Organic acids, Carbon, Silica, Pollutants, *Norway, *Scotland, Weak acids, Total organic carbon.

As part of their studies of acidification of rivers and lakes, the authors measured pH, strong and weak acids, as well as concentrations of major ions in lake-water samples collected regionally in southern Norway and in samples from small lakes and creeks in the New Galloway area, Scotland. Both sets of samples show a similar relationship between strong acid and H(+)-concentration calculated from the pH of the sample. If pH is higher than about 5.5, the strong acid concentration becomes negative, corresponding to the presence of bicarbonate or other bases. In the pH-range from 4.8 to 5.5 the strong acid concentration is usually positive, but less than the H(+)-concentration, indicating contributions from weak acids, which may have existed as bases before excess inputs of strong acids started. The variance in weak acid concentrations in lakes in southern Norway and in southwestern Scotland is largely explained by the concentrations of organic carbon and aluminum. Because of increased leaching of aluminum from the soil in areas where deposition of acid components from the atmosphere has increased, an increase in weak acid concentrations has probably also occurred. (Humphreys-ISWS).
W80-06391

ORGANOCHLORINE INSECTICIDES AND PCB IN THE SURFICIAL SEDIMENTS OF LAKE SUPERIOR (1973),
Ontario Ministry of Agriculture and Food, Guelph. Pesticide Residue Lab.
R. Frank, R. L. Thomas, H. E. Braun, J. Rasper, and R. Dawson.
Journal of Great Lakes Research, Vol 6, No 2, p 113-120, 1980. 4 Fig, 2 Tab, 20 Ref.

Descriptors: *Pesticide residues, *Lake Superior, *Sediments, Distribution patterns, Polychlorinated biphenyls, Halogenated pesticides, DDE, Endrin, Heptachlor, Sampling, Analysis, On-site data collections, Maps, Surveys, Average, Lake basins, Measurement, Gas chromatography, HEOD, Chlordane, Mirex, Endosulfan.

Samples of Lake Superior sediment at 0 to 3 cm depth were collected in 1973 on a 14.1 km Universal Transverse Mercater grid to map the concentrations of organochlorine insecticides and PCB in the sediments. The 405 sediment samples were extracted and subjected to gas chromatographic analysis to determine the organochlorine and PCB concentrations. Low levels of DDE, HEOD, and PCB were found, but no mirex, heptachlor epoxide, endosulfan, endrin, or chlordane residues were detected. p,p'-DDE was detected in 50% of the samples and concentrations of p,p'-DDE were found to be about two to seven times higher in the depositional basins than in the non-depositional zones. HEOD was identified in 99% of the samples and PCB in 44%. The distribution of PCB was fairly uniform throughout the sediment, although slightly higher concentrations were noted in basins near industrial areas. The levels of p,p'-DDE, HEOD, and PCB concentrations were lower than values reported by other workers because more sediment was collected per sample in this study. Mean residue concentrations for the lake are about: p,p'-DDE, .71 nanogram per gram; HEOD, below .25 nanogram per gram; and PCB, 3.3 nanogram per gram. (Sidney-IPA).
W80-06440

LIMNOLOGICAL SAMPLING INTENSITY IN LAKE ST. CLAIR IN RELATION TO DISTRIBUTION OF WATER MASSES,
Ontario Ministry of Natural Resources. Wheatley. Fisheries Research Station.

J. H. Leach.
Journal of Great Lakes Research, Vol 6, No 2, p 141-145, 1980. 5 Fig, 21 Ref.

Descriptors: *Limnology, *Sampling, *Distribution patterns, *Frequency, *Mathematical studies, Rivers, Water quality, Physical properties, Chemical properties, Winds, Turbulence, Wind tides, Lakes, Water properties, Surveys, Mapping, Onsite data collections, Lake Huron, Environment, Channels, Variability, Homogeneity, Nutrients, Correlation analysis, Statistical models, Lake St. Clair.

A reduction in the number of water samples necessary for water quality monitoring of Lake St. Clair is proposed. Factor and cluster analyses were carried out on physical and chemical data obtained in 1974 to compare sampling stations while considering all variables simultaneously. Two stable water masses were identified, one mass consisting mainly of Lake Huron water flowing from the main channels of the St. Claire River, and a southeastern mass of more stable, nutrient-rich water from the Sydenhan and Thames Rivers of Ontario. Wind direction did have some influence on the clustering of the sampling stations, but the two major discrete water masses remained intact. Data from just two or three index stations within the water masses would provide sufficient information for an evaluation of the offshore Lake St. Clair environment. Index data for several variables over a 5-year period for one station provided a good estimate for the whole water mass. Two sampling stations in Lake St. Clair would provide all the necessary environmental data with little loss of resolution. (Sidney-IPA).
W80-06443

POLYCHLORINATED BIPHENYL CONTAMINATION IN SURFICIAL SEDIMENTS OF NORTHEASTERN LAKE MICHIGAN,
Michigan Univ., Ann Arbor, MI. Dept. of Environmental and Industrial Health.
M. S. Simmons, D. I. Bialosky, and R. Rossmann.
Journal of Great Lakes Research, Vol 6, No 2, p 167-171, 1980. 4 Tab, 21 Ref.

Descriptors: *Polychlorinated biphenyls, *Lake Michigan, *Bottom sediments, *Testing, *Correlation analysis, Pesticide residues, Pollutants, Water pollution sources, Water pollution, Sediments, Clays, Silts, Fallout, Sediment control, Organic compounds, Deposition(Sediments), Chemical precipitation, Testing procedures, Gas chromatography, Carbon, Average, Sampling.

The polychlorinated biphenyl (PCB) concentrations in the sediments of northeastern Lake Michigan were determined and the data were correlated with sediment composition. Samples of the surficial sediments were collected in areas where there is little local urbanization and industrialization and analyzed by gas chromatography. The concentration of PCBs in the sediment test samples were relatively low, ranging from 1.6 to 6.7 microgram per liter and these values fall at or even below the low end range of values observed by other researchers. The PCB concentrations exhibited no distinct geological trends suggesting a diffuse source of PCBs, such as atmospheric deposition. The concentration of PCBs is highly correlated with the organic content in the sediment (r=.93) and the silt-clay fraction (r=.98). The organic carbon content is also highly correlated with the silt-clay fraction in the sediment samples. These results of this study probably cannot be generalized for the entire northeastern Lake Michigan region. (Sidney-IPA).
W80-06447

5B. Sources Of Pollution

MOVEMENT OF NITROGEN AND CARBON FROM A SEPTIC SYSTEM DRAINFIELD,
Connecticut Agricultural Experiment Station, New Haven.
J. L. Starr, and B. L. Sawhney.
Water, Air, and Soil Pollution, Vol 13, No 1, p 113-123, March 1980. 5 Fig, 14 Ref.

Descriptors: *Septic tanks, *path of pollutants, *Carbon, *Nitrogen, Sampling, Soil water, Precipitation(Atmospheric), Effluents, Nitrogen compounds, Nitrates, Ammonia, Waste disposal, Domestic wastes, Water pollution sources.

A septic system drainfield that had been in use for 6 yr was instrumented to study the vertical and horizontal movement of N and C. The original system was designed so that the effluent from the septic tank could be diverted to either of two parallel leaching trenchs. Each trench contained three precast leaching chambers (1.22 m x 2.44 m x 0.3 m) placed end to end at a depth of 1.4 m. Since installation each trench had been used alternately for 6 mo periods. In each of the 2 yr of this study, effluent began to pond in the leaching chamber within 24 h after the effluent was directed to that trench. Approximately 100 days were required to develop a quasi steady state with respect to the depth of ponding and concentrations of N and C in the soil solution. In both years of the study about 25% of the influent-N was mineralized. However, in the first year very little nitrification occurred while in the second year essentially all of the NH4 in the soil profile was nitrified and moved without apparent loss to the groundwater. These differences in N transformatin appeared to be indirectly controlled by rainfall with 50% less precipitation received in the second than in the first year. (Sims-ISWS)
W80-06212

METAL CONCENTRATIONS IN MARINE SEDIMENTS FROM LEBANON,
ARABCONSULT, Beirut (Lebanon).
For primary bibliographic entry see Field 5A.
W80-06213

INVESTIGATION OF LAKE ONTARIO WATER QUALITY NEAR PORT GRANBY RADIOACTIVE WASTE MANAGEMENT SITE,
National Water Research Inst., Burlington (Ontario).
R. W. Durham, and S. R. Joshi.
Water, Air, and Soil Pollution, Vol 13, No 1, p 17-26, March 1980. 1 Fig, 2 Tab, 11 Ref.

Descriptors: *Water pollution, *Radioactive wastes, *Lake Ontario, Sampling, Surveys, Data processing, Analytical techniques, Radioactive waste disposal, Pollutants, Path of pollutants, Water pollution sources, Radium radioisotopes, Arsenic radioisotopes, Nitrates, Water quality, Lakes.

The concentrations of 226Ra, As, and NO3(-) have been measured in Lake Ontario waters off Eldorado Nuclear Limited's Port Granby radioactive waste management site. Only one sample gave a 226Ra value higher than the Ontario criterion for public surface water supplies. the highest levels of As and No3(-) were below the Ontario criteria. The leachate plume appears to move parallel to the shoreline in the direction of the prevailing wind but disperses rapidly reaching ambient levels within 150 m of the source. The leaching of these pollutants has only a minor effect on the lake water quality. (Sims-ISWS)
W80-06214

QUALITY OF TIGRIS RIVER PASSING THROUGH BAGHDAD FOR IRRIGATION,
Environmental Pollution Research Centre, Baghdad (Iraq).
For primary bibliographic entry see Field 5A.
W80-06215

SIMULATION OF EFFECTS OF URBANIZATION ON STORMWATER RUNOFF AND QUALITY,
Tennessee Univ., Knoxville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4C.
W80-06223

LAKE ERIE: A NEW PROGNOSIS,
Ohio State Univ., Columbus, Dept of Agronomy.
T. S. Logan, and S. M. Yaksich.
Water Spectrum, Vol 12, No 3, p 26-34, Summer 1980. 9 Fig.

Descriptors: *Lake Erie, *Water pollution sources, *Water quality, *Nutrient removal, Fertilizers, Phosphorous compounds, Pesticide residues, Farm wastes, Heavy metals, Municipal wastes, Erosion, Erosion control, Land management, Topography, Soil management, Cultivation, Drainage effects, Industrial wastes, *Water pollution control.

The process of recovery for and the continuing pollution problems of Lake Erie are discussed. Lake Erie is the smallest of the Great Lakes and its small volume has helped speed its rehabilitation. Excessive nutrient loading by nitrogen and phosphorous compounds has caused algae growths, drinking water problems, and depletion of the oxygen supply in the lake. Heavy metal and pesticide concentrations will continue to be a concern. Reduction in the phosphorous loads to Lake Erie to a goal of 11,000 metric tons per year is necessary to eliminate the oxygen depletion problem. Discrete 'point sources' of phosphorous from municipal and industrial outfalls may be controlled, but 'diffuse source' loading (about 44% of the load) mostly from farm runoff is difficult to control. Soil erosion transports the soil-attached (particulate) phosphorous into the lake and this process is under careful investigation. The land-use and soil-type data for the Lake Erie drainage basin has been compiled by the Corps of Engineers and possible solutions have been proposed. Reduced tillage practices with less underturning of the soil can control erosion and therefore, phosphorous pollution. This control method is presently being demonstrated by the Honey Creek Watershed Management Project in northern Ohio. The restoration of Lake Erie has made significant progress. (Sidney-IPA)
W80-06233

TRAVELTIME, UNITE-CONCENTRATION, LONGITUDINAL-DISPERSION, AND REAERATION CHARACTERISTICS OF UPSTREAM REACHES OF THE YAMPA AND LITTLE SNAKE RIVERS, COLORADO AND WYOMING.
Geological Survey, Lakewood, Co. Water Resources Div.
D. P. Bauer, R. E. Rathbun, and H. W. Lowham.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-129521, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 78-122, November 1979. 66 p, 22 Fig, 12 Tab, 39 Ref.

Descriptors: *Model studies, *Rivers, *Colorado, *Wyoming, Streamflow, Water pollution, Regression analysis, Analytical techniques, Simulation analysis, Mathematical models, Equations, Travel time, Dispersion, Velocity, Shear drag, Tracers, Dye releases, *Yampa River(CO), Little Snake River(Colo-Wyo).

Measurements were made along a 58-mile reach of the Yampa River in Colorado and a 77-mile reach of the Little Snake River in Colorado and Wyoming to determine traveltime, unit-concentration, and longitudinal-dispersion characteristics. Two traveltime, unit-concentration, and dispersion analyses were made along the Yampa River when its average streamflow was approximately 100 and 3,400 cu ft/s; three traveltime, unit-concentration, and dispersion analyses were made along the Little Snake River when its average streamfow was approximately 200, 600, and 1,600 cu ft/s. Reaeration coefficients were determined only for the Yampa River, when its average streamflow was approximately 100 cu ft/s. Traveltime and unit-concentration simulations were made using a mathematical model. Data collected for the Little Snake River when the average streamflow was approximately 600 cu ft/s were used as a check of model-simulation accuracy. Traveltime simulations compared to within 5%, and unit-concentration simulations were within 30 to 40% of the measured flow data. Longitudinal-dispersion coefficients ranged from 400 to 6,050 sq ft/s for the two streams. Reaeration coefficients for the Yampa River, adjusted to 20

degrees celsius, ranged from 6.04 to 33.4 per day. Two semi-empirical equations gave reaeration coefficients in best agreement with measured reaeration coefficients. Absolute errors of estimate for these equations were 11.8 and 17.3%. (USGS)
W80-06239

EFFECT OF SURFACE COAL MINING ON THE HYDROLOGY OF CROOKED AND TURKEY CREEK BASINS, JEFFERSON COUNTY, ALABAMA,
Geological Survey, Tuscaloosa, AL. Water Resources Div.
C. Puene, and J. G. Newton.
Geological Survey Water-Resources Investigations 79-91, August 1979. 39 p, 18 Fig, 5 Tab, 21 Ref.

Descriptors: *Coal mine wastes, *Water pollution effects, *Streams, *Alabama, *Mine drainage, Sediment yield, Streamflow, Water quality, Water chemistry, Path of pollutants, *Warrior coal field(AL), *Jefferson County(AL).

Streamflow, sediment yield, and water quality were monitored from October 1975 through May 1977 to determine the impact of surface coal mining on the hydrology of Crooked and Turkey Creek basins in Jefferson County, Alabama. The basins are in the northeast part of the Warrior coal field. Coal is and has been mined from the Blue Creek, Mary Lee, and and Newcastel coal beds in the Mary Lee group. Results show water-quality degradation, increased sediment yields, and increased low flow in most tributaries draining mined areas. The impact of mine drainage and sediment yield from mined subbasins on water in the main stem of Turkey Creek was small due to the alkalinity of the water in the creek and to dilution ratios that ranged from 1:30 to 1:300. Mine drainage has affected the quality of water in Crooked Creek. The dissolved solids concentration in water downstream from the mined areas was as much as 7 times greater than that in water in unmined parts of the basin. The sediment yield to Crooked Creek was lower in the mined area than in the unmined segment of the stream. The lower yield is due, in part, to the trapping of sediment in sediment ponds in the mines and in a swamp downstream from the mines. (USGS)
W80-06240

HYBRID COOLING SYSTEM THERMODYNAMICS AND ECONOMICS,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
A. R. Giaquinta, T. E. Croley, II, and T. D. Hsu.
Journal of the Energy Division, American Society of Civil Engineers, Vol. 106, No. EY1, Proceedings Paper 15319, p 89-107, April 1980. 9 Fig, 2 Tab, 16 Ref, 1 Append. OWRT A-061-IA(2), 14-31-0001-5201.

Descriptors: *Cooling Water, *Powerplants, *Thermodynamics, *Economics, Model studies, Mathematical models, Design, Thermal powerplants, Energy, Heat, Optimization, Costs, Cooling, Equipment, Cooling towers, Rivers, Evaporation, Water supply, Cooling systems, Back pressure.

Wet cooling towers can be used as 'helper' systems with once-through cooling at riverside powerplant sites where the permissible river heat assimilation capacity is inadequate to absorb all of the waste heat. A comprehensive computer model was used for the thermodynamic analysis, economic assessment, and optimum design of once-through/wet tower hybrid cooling systems. Several different configurations were investigated, and results were presented for an 1,150 MW nuclear power plant located on the Missouri River at Sioux City, Iowa. The hybrid cooling system arranged in a series water path with a partially closed-cycle loop appears to be the most economical configuration for the site conditions studied when zero water costs are used. Comparison of hybrid systems with once-through cooling and closed-cycle wet tower systems indicated that hybrid cooling systems are economically superior. A trade-off function between total cost and water evaporation was presented to indicate the best hybrid arrangement for sites where water availability is limited. (Sims-ISWS).
W80-06250

THE TEMPORAL VARIATIONS OF LEAD CONCENTRATION IN A FRESHWATER LAKE,
California State Coll. Stanislaus, Turlock. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W80-06253

EVALUATION OF THE IMPACT OF TEXAS LIGNITE DEVELOPMENT ON TEXAS WATER RESOURCES,
Texas A and M Univ., College Station. Dept. of Geology.
For primary bibliographic entry see Field 4C.
W80-06261

COLUMN DYNAMICS OF TERNARY ION EXCHANGE PART I: DIFFUSIONAL AND MASS TRANSFER RELATONS,
California Univ., Berkeley. Dept. of Chemical Engineering.
O. O. Omatete, R. N. Clazie, and T. Vermeulen.
The Chemical Engineering Journal. Vol 19, p 229-240, 1980. (California Water Resources Center Project S-172).

Descriptors: *Ion-Exchange, *Diffusion, *Thermodynamics, *Mass transfer, Equations, Numerical analysis.

The complete multicomponent ion-exchange diffusion equations based on irreversible thermodynamics and their approximations by the Nernst-Planck model or the Fick's law model are all put in the same algebraic form. Their differences occur only in the definition of the diffusion coefficients. Multicomponent diffusion coefficients are related to those in binary systems by either the Nernst-Planck or Fick's law model. Using a linear driving force approximation for the flux equations, similar relationships are developed for estimation multicomponent (ternary) mass transfer coefficients based on the analysis of binary data. Hence from binary data and these relationships, multicomponent effluent concentration histories may be predicted numerically. (See also W80-06271) (Snyder-California)
W80-06270

COLUMN DYNAMICS OF TERNARY ION EXCHANGE PART II: SOLUTION MASS TRANSFER CONTROLLING,
California Univ., Berkeley. Dept. of Chemical Engineering.
O. O. Omatete, R. N. Clazie, and T. Vermeulen.
The Chemical Engineering Journal, Vol 19, p 241-250, 1980. (California Water Resources Center Project S-172).

Descriptors: *Ion-Exchange, *Diffusion, *Thermodynamic, *Mass transfer, Model studies, Ternay system(Ag-Na-H).

The nonequilibrium theory for column dynamics of multicomponent ion exchange has been evaluated using the ternary system Ag-Na-H at a total solution concentration of 0.05 N (0.05 M) so that solution mass transfer controls the exchange. Ternary mass transfer coefficients have been related to binary values by both simple (constant) and improved (concentration-dependent) Fick's law models, as well as by simple and improved Nernst-Planck models. Binary coefficients of all four types were obtained directly from constant-pattern binary break throughs and the individual-component Nerst-Planck coefficients were derived from the binary coefficients. Using each of the four models, ternary effluent concentration histories (ECH) were predicted using the method of characteristics. All the models predicted effluent concentration histories that matched closely the experimental ones, indicating that either model may be used satisfactorily for prediction, the simple models are preferred to the improved ones since they contain fewer parameters. (See also W80-06270) (Snyder-California)
W80-06271

BIOTRANSFORMATION OF SELECTED CHEMICALS BY FISH,
National Fishery Research Lab., LaCrosse, WI.
J. L. Allen, V. K. Dawson, and J. B. Hunn.
In: Pesticide and Xenobiotic Metabolism in Aquatic Organisms, M.A.Q. Khan, J. J. Lech and J. J. Menn, Ed., ACS Symposium Series, No. 99, p. 121-129, 1979. 1 Fig, 36 Ref.

Descriptors: *Fish Physiology, *Freshwater Fish, *Pesticide Kinetics, Animal Metabolism, Rainbow Trout, Carp, Sockeye Salmon, Chemical Reactions, Biochemistry, Chemical Properties, Path of Pollutants, Chemical Analysis, *Biotransformation, *TFM, *Bayer 73, *Lampricides, *Fish Anesthetics, Anesthetics, *Piscaine, *MS-222, *Thanite, *Dinitramine, *Tissue Analysis.

Biotransformation of selected chemicals by freshwater fish is accomplished through a diversity of biochemical pathways. Biliary and renal excretion of glucuronide conjugates of two lampricides, 3-trifluoromethyl-4-nitrophenol (TFM) and 2', 5-dichloro-4'-nitrosalicylanilide (Bayer 73), have been demonstrated. Glucuronide conjugation has also been demonstrated with the fish anesthetic, 2-amino-4-phenylthiazole (Piscaine). Preliminary studies have indicated that fish are capable of hydrolyzing Bayer 73 to two fragments, 5-chlorosalicylic acid and 2-chloro-4-nitroaniline. Hydrolysis of the ester linkage of methane sulfonate of m-aminobenzoic acid ethyl ester (MS-222) to form m-aminobenzoic acid has been shown in freshwater and saltwater fish. Amino groups in MS-222 and Piscaine are subject to N-acetylation. Most of the acid metabolites of the fish anesthetics are excreted renally. Dealkylation of a substituted amine was shown by the stepwise deethylation of dinitramine (N3, N3-diethyl-2, 4-dinitro-6-trifluoromethyl-m-phenylenediamine) in carp (Cyprinus carpio). Fish are also capable of biotransformation involving substitution; fish exposed to Thanite (isobornyl thiocyanoacetate) apparently release cyanide by substituting a methyl group to form isobornyl-a-(methylthio)acetate. (Deal-EIS).
W80-06275

COMPARATIVE TOXICITY OF ARSENIC COMPOUNDS AND THEIR ACCUMULATION IN INVERTEBRATES AND FISH,
Environmental Research Lab.-Duluth, MN.
R. L. Spehar, J. T. Fiandt, R. L. Anderson, and D. L. DeFoe.
Archives of Environmental Contamination and Toxicology, Vol. 9, p. 53-63, 1980. 4 Fig, 2 Tab, 39 Ref.

Descriptors: *Arsenic Compounds, *Toxicity, *Invertebrates, *Rainbow Trout, Daphnia, Snails, Amphipoda, Stoneflies, Bioassay, Path of Pollutants, Aquatic Insects, Mortality, Reproduction, *Arsenic, *Bioaccumulation, *Tissue Analysis, Arsenic III, Arsenic V, Arsenates.

The toxicity of arsenic III, arsenic V, sodium dimethyl arsenate, and disodium methyl arsenate to stonefiles, snails, amphipods, and trout, and the bio-accumulation of these compounds were studied during a 28-day flow-through test. Daphnia magna were exposed for 21 days in static tests to determine life-cycle effects. All animals were exposed to concentrations of approximately 100 and 1000 microg/L (as arsenic) of each of the compounds. Arsenic III, the most toxic compound, caused a significant reduction in the survival of amphipods at 1000 microg As/L after seven days. None of the compounds significantly affected the survival of other test species after 28 days or reduced young production in Daphnia after 14 days of exposure. The concentration of accumulated arsenic in stoneflies, snails, and Daphnia was as much as 131, 99, and 219 times greater than the water concentration, whereas amphipods and rainbow trout contained arsenic residues similar to the controls. Residues in stoneflies, snails, and Daphnia exposed to 1000 microg As/L were higher than those in animals exposed to 100 microg As/L, but appeared to reach a steady state after 14 days. Total arsenic accumulation was greatest in organisms exposed to

inorganic arsenic, particularly at 100 microg/L. (Deal-EIS).
W80-06276

UPTAKE, METABOLISM, AND ELIMINATION OF THE LAMPRICIDE 3-TRIFLUOROMETHYL-4 NITROPHENOL BY LARGEMOUTH BASS (MICROPTERUS SALMOIDES),
Fish and Wildlife Service, Warm Springs, GA. Southeastern Fish Control Lab.
D. P. Schultz, P. D. Harman, and C. W. Luhning.
Journal of Agricultural and Food Chemistry, Vol 27, No 2, p 328-331, 1979. 4 Tab, 12 Ref.

Descriptors: *Pesticide kinetics, *Pesticide residues, *Bass, *Fish phsiology, Animal metabolism, Biochemistry, Absorption, Tracers, Carbon radioisotopes, Radiochemical analysis, *TFM, *Lampricides, *Bioaccumulation, *Tissue analysis.

Largemouth bass exposed to a 1.0 microg mL solution of the lampricide 3-trifluoromethy1-4 nitro(14C)phenol(TFM) for up to 24 h accumulated radioactive residues in all tissues analyzed at each of five successive sampling periods. Maximum concentrations occurred after 8 h in brain and muscle and after 12 h in blood, liver, kidniey, and head plus viscera. Concentrations of radioactivity in the bile increased throughout the experiment. In a second group of fish exposed to 1.0 microg mL of (14C)TFM for 12 h and then transferred to lampricide-free flowing water, the concentration of radioactive materials in tissues generally decreased with time throughout a 72-h elimination period. No TFM was detected in muscle tissue 12 h after the fish were transferred to lampricide-free water. The presence of conjugated TFM in the bile was confirmed. Hexane/ether extracts contained (14C)TFM and other unidentified 14C materials from muscle and head plus viscera, whereas methanol extracts taken after the hexane/ether extraction contained only a negligible amount of (14C)TFM but large quantities of unidentified, polar 14C compounds. (Deal-EIS)
W80-06281

DIELDRIN IN A RIVER CATCHMENT AND POTENTIAL METHODS OF REMOVAL,
Plymouth Polytechnic (England), Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5D.
W80-06283

A HYDROGEOCHEMICAL SURVEY OF THE CHALK GROUNDWATER OF THE BANSTEAD AREA, SURVEY, WITH PARTICULAR REFERENCE TO NITRATE,
Water Research Centre, Marlow (England). Resources Div.
C. P. Young, and M. Morgan-Jones.
Journal of the Institution of Water Engineers and Scientists, Vol 34, No 3, p 213-236, May 1980. 13 Fig, 7 Tab, 33 Ref.

Descriptors: *Hydrogeology, *Groundwater, *Water quality, *Nitrates, Surveys, Aquifers, On-site investigations, Profiles, Ammonia, Test wells, Iron, Manganese, Potassium, Calcium, Ions, Data collections, Tritium, Water sampling, Hydrogen ion concentration, Water temperature, Foreign countries, *Surrey(England), Hydrogeochemistriy.

This paper recorded a collaborative investigation by the Water Research Center and the Thames Water Authority initiated in 1977. The study area lies some 25 km southwest of Central London on the dip slope of the North Downs within the Sutton District Water Company's supply catchment. Pumped water samples for chemical analysis were obtaine from nine major public supply sources, with additional samples from 10 observation boreholes for analysis of selected determinands. Four cored boreholes were drilled to a maximum depth of 82 m below ground level, and analyses were made of nitrate and other solutes in the interstitial water. Examination of the analyses for the major cations and anions in the samples has shown the groundwater to be of a typical calcium bicarbonate type characteristic of the Chalk aquifer. A seasonal variation in the concentrations of certain solutes indicates that a proportion of the recharge moves rapidly from the surface of the water table, especially in areas with a thin unsaturated zone. With the exception of lead, trace metals in the repeated samples showed no significat variations, occasional higher being attributed to contamination by borehole casings or headworks. The limited evidence available suggests that nitrate-rich groundwater is generally restricted to the upper layers of the water table. A comparison of measured tritium concentrations in the interstitial water of the unsaturated Chalk with historical tritium in rainfall data indicates that a high proportion of infiltration moves vertically at rate of between 0.8 and 1.0 m/year. The distribution of nitrate in the saturated zone is broadly consistent with a slow downwards movement from the surface, with the highest values being associated with boreholes in the northern part of the area where the unsaturated zone is thinnest. (Humphreys-ISWS)
W80-06285

APPLICATION OF THE CONTINUOUS STORMWATER POLLUTION SIMULATION SYSTEM (CSPSS): PHILADELPHIA CASE STUDY,
CH2M/HILL, Inc., Gainesville, FL.
R. L. Wycoff, and U. P. Singh.
Water Resources Bulletin, Vol 16, No 3, p 463-470, June 1980. 7 Fig, 6 Tab, 7 Ref. EPA 68-01-3993.

Descriptors: *Water pollution, *Storm water, *Urban runoff, *Combined sewers, *Model studies, Mathematical models, Simulation analysis, Water quality, Waste water treatment, Rainfall, Runoff, Infiltration, Overflow, Sewers, Pollutants, Flow, Oxygen, Dissolved oxygen, *Philadelphia (PA), Water quality modeling, Combined sewer overflow, Receiving waters.

This paper described the Continuous Stormwater Pollution Simulation System (CSPSS) as well as a site-specific application of CSPSS to the Philadelphia urban area and its receiving water, the Delaware Estuary. Conceptually, CSPSS simulates the quantity and quality of urban stormwater runoff, combined sewer overflow, municipal and industrial wastewater effluent, and upstream flow on a continuous basis for each time step in the simulation period. In addition, receiving water dissolved oxygen, suspended solids, and lead concentrations resulting from these pollutant sources may be simulated. However, only receiving water dissolved oxygen (DO) response is considered in this paper. The continuous DO receiving water response model was calibrated to existing conditions using observed data at Chester, Pennsylvania, located on the Delaware Estuary approximately 10 miles downstream from the study area. Average annual pollutant loads to the receiving water were estimated for all major sources, and receiving water quality improvements resulting from removal of various portions of these pollutant loads were estimated by application of the calibrated simulation model. It was found that the removal of oxygen-demanding pollutants from combined sewer overflow and urban stormwater runoff would result in relatively minor improvements in the overall dissolved oxygen resources of the Delaware Estuary; whereas removal of oxygen-demanding pollutants from wastewater treatment plant effluent would result in greater improvements. The results of this investigation can be used along with appropriate economic techniques to identify the most cost-effective mix of point and nonpoint source pollution control measures. (Sims-ISWS).
W80-06307

IRRIGATION WATER AND SURFACE RUNOFF QUALITY AND QUANTITY IN CARSON VALLEY, NEVADA,
Nevada Univ., Reno. Div. of Plants, Soil, and Water Science.
J. C. Guitjens, and W. W. Miller.
Water Resources Bulletin, Vol. 16, No 3, p 459-462, June 1980. 2 Fig, 4 Tab, 8 Ref.

Descriptors: *Water quality, *Irrigation, *Return flow, *Nevada, Nutrients, Salts, Oxygen, Biochemical oxygen demand, Phosphorus, Phosphates, Nitrates, Dissolved solids, Sampling, Chemical analysis, Water pollution, Water pollution sources, Agriculture, Irrigation water, Surface runoff.

Best management practices for irrigated agriculture are not restricted to the control of sediments in the return flow. Salts and nutrient loading and oxygen depletion are also of environmental concern. Since knowledge of waste loading returned from agricultural irrigation is limited, specific characterization of irrigation and runoff water qaulity should precede corrective measures. In 1974, 1975, and 1976, four study sites within a 50,000-acre irrigated area were monitored to characterize the quantity and quality of irrigation water and surface return flow. Simple correlations among constituents showed strong relationships among BOD, TP, P04-P, and N03-N. Least significant difference tests among seasonal means of changes-in-load per irrigation showed that only TDS and p0-4 P were significant. (Sims-ISWS)
W80-06308

PERCOLATE WATER AND BROMIDE MOVEMENT IN THE ROOT ZONE OF EFFLUENT IRRIGATION SITES,
Oklahoma State Univ., Stillwater. Dept. of Forestry.
L. C. Tennyson, and C. D. Settergren.
Water Resources Bulletin, Vol 16, No 3, p 433-437, June 1980. 3 Fig, 3 Tab, 17 Ref.

Descriptors: *Sewage effluents, *Irrigation, *Soil moisture, *Tracers, Bromides, Laboratory tests, On-site investigations, Soil water movement, Percolation, Infiltration, Hydraulic conductivity, Water chemistry, Neutron activation analysis, Pollutants, Path of pollutants, Sewage effluent irrigation.

A bromide tracer was used to evaluate percolate water and ion movement in the upper 1.2 m of soil at a proposed sewage effluent irrigation site located in the Missouri Ozarks. Two plots representing Doniphan silt loam and Crider silt loam soils were sprinkler irrigated with local groundwater at a rate of 7.62 cm/week from June through August 1976. Soil water potential, percent soil moisture by volume, and background levels of bromide in soil water, groundwater, and precipitation were measured at the study plots. Bromide exchange properties and saturated hydraulic conductivity of the soils were determined in the laboratory. During two selected time periods, irrigation water was spiked with NaBr (5.0 mg/1 Br(-). Bromide movement through the upper profile was quantified by soil water samples and post-sampling neutron activation analysis. Soil moisture was near saturation in both soils when the Br(-) tracer was applied. Bromide concentrations above background levels (0.023 mg/1 Br(-), Doniphan silt loam and 0.016 mg/1 Br(-), Crider silt loam) were detected within 2.60 hours at 0.9 m in the Doniphan soil and within 3.75 hours at that depth in the Crider soil. The rate of Br(-) movement in the profile was greater in both soils than the measured saturated hydraulic conductivity. Bromide concentrations above background levels were present in soil water from the study plots for a minimum of 21 days after irrigation with the Br(-) tracer. (Sims-ISWS).
W80-06309

NUMERICAL MODELING OF LIQUID WASTE INJECTION INTO A TWO-PHASE FLUID SYSTEM,
Hawaii Univ., Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 5E.
W80-06318

THE GEOCHEMICAL PARTITIONING AND BIOAVAILABILITY OF TRACE METALS IN MARINE SEDIMENTS,
Oregon State Univ., Corvallis. Dept. of Civil Engineering.
S. M. Oakley, K. J. Williamson, and P. O. Nelson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-220205, Price codes: A05 in paper copy, A01 in microfiche.

Water Resources Research Institute, Oregon State University, Corvallis, Project Completion Report, July 1980. 84 p, 36 Fig, 5 Tab, 73 Ref. OWRT-A-044-ORE (1), 14-34-0001-9039.

Descriptors: *Trace metals, *Sediments, Bioavailability, *Model studies, *Estuarine environment, *Marine sediments, Trace elements, Heavy metals, Geochemistry.

Trace metals in the aquatic environment are generally concentrated on solid geochemical phases which eventually become incorporated into estuarine and marine sediments. The mechanism of trace metal concentration is believed to be adsorption with various geochemical phases such as hydrous metal oxides, clays, and organic metter. Metals in estuarine or marine sediments can thus be expected to be partitioned between different phases, depending on the concentration of the phase and the strength of the adsorption bond. The bioavailability of sediment-bound metals to deposit-feeding organisms will depend on trace metal partitioning and the kinetics of biological metal uptake from each geochemical phase. The present study was undertaken to develop models for trace metal partitioning and bioavailability in marine sediments. An equilibrium adsorption model was developed that can be used to predict the partitioning of trace metals between different geochemical phases in aquatic sediments from laboratory studies. The model uses conditional equilibrium constants determined from the linear portion of an adsorption isotherm. Conditional equilibrium constants determined for the adsorption of Cu and Cd on bentonite clay, Fe(OH)3, MnO2, and jumic acid in seawater show that the model is applicable for trace metal concentrations existing in the natural environment. Based on the laboratory results, the model predicts that the clay fraction may be a major sink for Cu and Cd in marine sediments. W80-06333

PROPERTIES AND CIRCULATION OF SAN FRANCISCO BAY WATERS,
Geological Survey, Menlo Park, CA, Water Resources Div.
For primary bibliographic entry see Field 2L.
W80-06334

SOURCES AND SINKS OF BIOLOGICALLY REACTIVE OXYGEN, CARBON, NITROGEN, AND SILICA IN NORTHERN SAN FRANCISCO BAY,
Geological Survey, Menlo Park, CA, Water Resources Div.
For primary bibliographic entry see Field 2L.
W80-06337

CORE SAMPLING BENEATH LOW-LEVEL RADIOACTIVE-WASTE BURIAL TRENCHES, WEST VALLEY, CATTARAUGUS COUNTY, NEW YORK,
Geological Survey, Albany, NY, Water Resources Div.
D. E. Prudic.
Available from OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $7.75 in paper copy, $3.50 in microfiche. Geological Survey open-file report 79-1532, 1979. 55 p, 25 Fig, 4 Tab, 14 Ref.

Descriptors: *Radioactive waste disposal, *Water analysis, *Sampling, *Sites, Drilling, Cores, Trenches, Landfills, Wells, Groundwater movement, Radiochemical analysis, Radioisotopes, Radioactive well logging, Water pollution sources, New York, *West Valley(NY), *Cattaraugus County(NY), *Radioactive waste burial.

A technique was developed for collecting cores for radiometric analysis from beneath a low-level radioactive-waste landfill to determine the rates of downward radionuclide migration below the trenches. A closed pipe was driven through the buried waste, and a removable point withdrawn. The hole was then advanced by alternately pushing a coring device, then driving an inner casing to the depth reached by the coring device and cleaning out cuttings from within the casing. The effectiveness of the technique was limited by inability to predict the location of impenetrable objects within the waste in some parts of the burial ground and difficulty in detecting when the end of the pipe first penetrated undisturbed material beneath the trench floor. Geophysical logs of the completed hole were used to help determine the trench-floor depth. (USGS).
W80-06350

SOURCE AREAS OF SALINITY AND TRENDS OF SALT LOADS IN STREAMFLOW IN THE UPPER COLORADO RIVER, TEXAS,
Geological Survey, Austin, TX. Water Resources Div.
J. Rawson.
Available from OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $8.50 in paper copy, $4.00 in microfiche. Geological Survey open-file report 80-224, 1980. 66 p, 12 Fig, 4 Tab, 11 Ref.

Descriptors: *Salinity, *Streamflow, *Colorado River, *Texas, Water pollution sources, Water quality, *Low flow, Geology, Dissolved solids, Chemical analysis, Brines, Diversion, *Upper Colorado River(TX).

A series of seven studies of the quality and quantity of low flows in a 35.5-mile reach of the Colorado River upstream from Colorado City, TX, were made from February 1975 to March 1978 to delineate areas of saline inflow. Salt-load trend studies for three long-term continuous streamflow and daily water-quality stations show that the salinity of the flow upstream from Ira (mile 826.3) increased significantly after 1963, but decreased significantly after 1970. The low-flow and salt-load trend studies indicate that part of the salinity in the flow of the Colorado River has resulted from the inflow of oil-field brine; but preponderant evidence indicates that the major part of the salinity is of natural origin. Neither the ban on open-pit disposal nor pumping of saline ground water has significantly reduced the salinity of flow downstream from Cuthbert (mile 810.6). (USGS).
W80-06357

STRONG AND WEAK ACIDS IN SURFACE WATERS OF SOUTHERN NORWAY AND SOUTHWESTERN SCOTLAND,
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 5A.
W80-06391

A DERIVATION OF THE MACROSCOPIC SOLUTE TRANSPORT EQUATION FOR HOMOGENEOUS, SATURATED, POROUS MEDIA,
California Univ., Riverside. Dept. of Physics.
For primary bibliographic entry see Field 2G.
W80-06397

AN APPROACH TO THE FRACTURE HYDROLOGY AT STRIPA: PRELIMINARY RESULTS,
University of Waterloo, Canada. Dept. of Earth Sciences.
For primary bibliographic entry see Field 5E.
W80-06411

ORGANIZING TO COPE WITH HAZARDOUS MATERIAL SPILLS,
Ryckman's Emergency Action, St. Louis, MO.
D. W. Ryckman, and M. D. Ryckman.
American Water Works Association Journal, Vol 72, No 1, p 196-200, January 1980. 3 Fig, 12 Ref.

Descriptors: *Oil spills, *Hazardous wastes, *Accidents, Planning, Systems analysis, Scientific personnel, Decision making, Communication, Transportation, Equipment, Information exchange, Computer programs, On-site laboratories, Monitoring, Water pollution sources.

A management system is described which can serve as a guide for water utilities in preparing spill prevention control and contingency plans and in developing individualized response systems for hazardous material spills that threaten drinking water supplies. The most important component in dealing with spills is a fast response. The system should have experienced scientists and engineers, operators, researchers, and medical personnel available on a 24-hours a day, seven days a week basis. One person with an ability to rapidly evaluate the situation, make on-the-spot engineering decisions, and supervise all field response activities. The system should have good communication and transportation networks for efficient transfer and coordination of people, information and equipment. There should be a system of warehouses and supplies of specialized equipment and materials for treatment, recovery and disposal. A computer assist program should be available to immediately provide pertinent information so that appropriate response measures may be implemented. Both central and field laboratories should be used for material identification and monitoring. Three case histories are described to illustrate application of the system to hazardous material spills involving alcohol and monononylphenol, gasoline, and oil. (Purdin-NWWA).
W80-06419

GROUND WATER MODELING IN SUBSURFACE NUCLEAR WASTE DISPOSAL -- AN OVERVIEW,
California Univ., Berkeley. Lawrence Berkeley Lab.
T. N. Narasimhan.
Transactions American Nuclear Society, Vol 32, p 116-117, June 1979. 9 Ref.

Descriptors: *Radioactive waste disposal, *Groundwater movement, *Computer models, Model studies, Mass transfer, Radioisotopes, *Path of pollutants, Numerical analysis, Equations, Advection.

This paper attempts to assess the ability of existing ground water models to accurately simulate regional ground water flow, flow perturbations caused by thermal loading near a repository, and transport of radioactive contaminants to the biosphere. For long-term effects, thermal phenomena can be ignored and two types of conservation equations, one for fluid flow and one for each chemical species transported, must be considered. With suitable assumptions the two equations can be extended to fractured media. Advective transport can be solved through correction factors, improved gradient approximations, the method of characteristics, or random-walk techniques. Despite active research, there are gaps between the conceptual model and the physical system and the computational model. All model parameters are subject to uncertainties due to the size of the portion of flow region sampled and the number of samples. Computational problems exist with respect to minimizing integration errors, handling discontinuities, and so on. Computational difficulties can be overcome by improving solution strategies. However, the basic problems related to parameter uncertainties may continue well into the future. (Purdin-NWWA).
W80-06434

SIMULATION OF RECENT AND PROJECTED TOTAL PHOSPHORUS TRENDS IN LAKE ONTARIO,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
S. C. Chapra.
Journal of Great Lakes Research, Vol 6, No 2, p 101-112, 1980. 11 Fig, 3 Tab, 37 Ref.

Descriptors: *Mathematical models, *Lake Ontario, *Eutrophication, *Water quality, *Projections, Evaluation, Model studies, Synthetic hydrology, Estimating equations, Time series analysis, Phosphorus compounds, Nutrients, Runoff, Rivers, Algae, Lake Erie, Control, Environmental control, Mesotrophy, Oligotrophy, Hydrology, Nutrient removal, Water pollution sources, Detergents, Fallout, Lake stages.

A mathematical simulation study of recent trends (1965 through 1978) in phosphorus loading and response of Lake Ontario was performed to sub-

stantiate the trends obtained from simple mass balance calculations. A total phosphorus budget model containing time-variable terms was derived to account for year-to-year characteristics of the system. The calculated loadings depend on point source contributions, inflow parameters from Lake Erie, atmospheric inputs, spring phosphorus input, and hydrologic and morphometric features of Lake Ontario. It was apparent from the future simulations that present phosphorus controls will maintain the lake at a level of mesotrophy (15 to 20 microgram P per liter) to the year 2000, whereas it would have become solidly eutrophic had no controls been implemented. Land runoff and Lake Erie reductions are necessary if oligotrophy (about 10 microgram P per liter) is the ultimate goal for Lake Ontario. The accuracy of the model was assessed and it was noted that runoff factors gave 'biologically available' phosphorus concentrations that represent over a 50% decrease in land runoff loading. The phosphorus model was based on eastern Lake Erie's mid-lake P contribution; tributary loadings were based on the 'on-lake point' model; and the Lake Erie outlet P concentrations were based on the 'high Erie model' -- all of which contributed to model uncertainty. (Sidney-IPA).
W80-06439

IMPACT OF PAST MINING ACTIVITIES ON AQUATIC SEDIMENTS IN MOIRA RIVER BASIN, ONTARIO,
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
A. Mudroch, and J. A. Capobianco.
Journal of Great Lakes Research, Vol 6, No 2, p 121-128, 1980. 5 Fig, 2 Tab, 20 Ref.

Descriptors: *Trace elements, *Water pollution sources, *Mine wastes, Rivers, Flow, Transfer, Sampling, Analysis, Water quality, Environment, Ecology, Water chemistry, Bottom sediments, Nickel, Cobalt, Copper, Lead, Zinc, Chromium, Mercury, Sediments, Arsenic, Smelting.

Water and bottom sediment samples from fourteen stations in the Moira River and the Bay of Quinte, Ontario, were collected and analyzed to determine the transport of trace elements through the system. Concentration profiles of Ni, Co, Cu, Pd, Zn, Cr, Hg, Ag, and As provide information about the impact of man's activities in an area affected by past mining and smelting activities. Analysis of Si, Al, Fe, Mg, K, and Na concentrations revealed no significant enrichment, but elevated levels of As, Cu, Co, and Ni were found in sediments collected from Bend Bay and Moira Lake situated below the old Deloro Mining and Smelting Co. operation at Deloro. A decrease in Co, Ni, and Cu concentrations was noted in the top of the sediment profiles, which corresponds to post-1960 deposition after the smelting and mining plant was shut down. Arsenic is still being added to the system somewhere above Bend Bay, probably from the waste pits at Deloro, and water samples collected downstream contained 250 microgram As per liter. The trace element content in the sediment decreased with increasing distance from the Deloro operation and its impact extends approximately to Stoco Lake, 40 to 45 km downstream from Deloro. (Sidney-IPA).
W80-06441

5C. Effects Of Pollution

SALINE-SEEP DEVELOPMENT IN THE HAILSTONE BASIN, NORTHERN STILLWATER COUNTY, MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 3C.
W80-06243

ROLE OF NUTRIENT LIMITATION AND COMPETITION IN CONTROLLING THE POPULATIONS OF A DIATOM AND A BLUE-GREEN ALGA,
Wisconsin Univ., Madison.
N. L. Peterson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80 223571, Price codes: A07 in paper copy, A01 in microfiche. MS Thesis, 1979, 132 p 16 Fig, 21 Tab, 114 Ref, Append. OWRT B-101-WISC(1), 14-34-0001-8128.

Descriptors: *Nutrients, Competition, Dominant organisms, *Algae, *Cyanophyta, *Diatoms, Phosphorus, *Algal control.

Changing patterns of species composition or seasonal succession in phytoplankton communities have been observed in freshwater and marine ecosystems. Nutrient uptake and the growth kinetics of different species could be important factors that determine which species dominate in competition although other physical, chemical and biological factors may also be involved. The nutrient kinetics and competition between a diatom, Asterionella formosa, and a blue-green alga, Microcystis aeruginosa, were examined in laboratory studies. Phosphorus and Si, two of the nutrients most often limiting in freshwater lakes, were investigated. The studies were conducted to: (1) Establish the uptake and growth kinetics of P and Si under set light and temperature conditions; (2) examine the long-term outcome of the competition between the two species studied under various nutrient conditions; (3) evaluate the use of nutrient kinetic parameters and the role of nutrient limitation in predicting and interpreting the results of competition studies.
W80-06265

SECRETORY IGM, LYSOZYME AND LYMPHOCYTES IN THE SKIN MUCUS OF THE CHANNEL CATFISH, ICTALURUS PUNCTATUS,
Memphis State Univ., TN. Dept of Biology.
D. D. Ourth.
Developmental and Comparative Immunology, Vol 4, p 65-74, 1980. 2 Fig, 30 Ref. OWRT A-056-TENN(2), 14-34-0001-9045.

Descriptors: *Catfishes, Salmonella, Fish physiology, Bacteria, Fish disease immunity, *Skin mucus, Immunology.

Channel catfish (Ictalurus punctatus) skin mucus demonstrated immunological response. Agglutinating antibody and bactericidal activity to Salmonella paratyphi were found in the mucus after intraperitoneal injection of bacteria. By immunodiffusion in gel, catfish skin mucus gave a precipitin line to identity with catfish 14S serum macroglobulin against rabbit anti-catfish 14S serum indicating the presence of secretory IgM in the mucus. Parenteral immunization (intraperitoneally) can thus yield specific IgM antibody in the mucus. Lysozyme was also demonstrated in the mucus as well as lymphocytes.
W80-06268

MORPHOLOGICAL FORM PHOTOSYNTHETIC PERFORMANCES OF MARINE MACROALGAE: TESTS OF A FUNCTIONAL/FORM HYPOTHESIS,
California Univ., Irvine. Dept. of Ecology and Evolutionary Biology.
M. M. Littler.
Botanica Marine, Vol 22, p 161-165, 1980. 3 Fig. (California Water Resources Center Project UCAL-WRC-W-491).

Descriptors: *Marine algae, *Algae, *Productivity, *Intertidal areas, *Photosynthesis, Biological communities, Benthic algae, Light intensity, Nutrients, Productivity estimates.

Net and gross production rates were determined in the field at light intensities above 20,000 lux for 45 species of marine macroalgae from four different environments in southwestern North America. Thin sheetlike and finely branched thallus-forms showed greater rates than other forms. A morphological form more suited to efficiently utilize light energy and obtain nutrients is clearly related to the differences measured. There was a close relationship between dry weight as well as two-dimensional thallus area and photosynthetic performance for macrophytes having relatively large surface areas (e.e., thin and finely branched forms). However, the productivity values for the range of coarsely-branched to encrusting forms were in closer agreement with respect to thallus area than with respect to dry weight.
W80-06269

CANDIDATE CHEMICALS FOR CRUSTACEAN CULTURE,
Fish and Wildlife Service, LaCrosse, WI. Fish Control Lab.
R. A. Schnick, F. P. Meyer, L. L. Marking, T. D. Bills, and J. H. Chandler, Jr.
In: Proceedings of the Second Biennial Crustacean Health Workshop, Texas A & M University Report TAMV-SG-79-114, Lewis, D. H. and J. K. Leong, Eds., p. 245-294, 1979. 3 Tab, 52 Ref.

Descriptors: *Crustaceans, *Aquiculture, *Pesticides, Bioassay, Chemical properties, Animal Parasites, Regulation, Legal Aspects, Public health, Herbicides, Invertebrates, Freshwater Fish, Water quality standards, Pesticide residues, Pesticide kinetics.

This report was compiled to evaluate the chemicals that are being used or tested in crustacean culture so that the most promising candidates can be selected for registration. A number of chemicals are used in crustacean culture to control diseases, to anesthetize organisms, or to alleviate cultural problems. Chemotherapeutants and anesthetics are listed with their potential uses, efficacy data, relative toxicity, crustacean species treated, and literature references. Data from standard toxicity tests performed at the Fish Control Laboratories with four therapeutants, on one crustacean species and three species of fish, are included for comparison. Few chemicals have been approved by the Food and Drug Administration (FDA) or the Environmental Protection Agency (EPA) for use on crustaceans. Even though a compound may be registered for use on fish, data to support a label extension must be filed with FDA or EPA before the compound can legally be used to treat crustaceans intended for human consumption. Until adequate registrations become available, it is suggested that researchers in crustacean culture consider using only compounds that are approved for use on crustaceans or have a history of safe use in fish culture. (Deal-EIS).
W80-06274

CHRONIC EFFECT OF COPPER ON THE BLUNTNOSE MINNOW, PIMEPHALES NOTATUS (RAFINESQUE),
Environmental Research Lab.-Duluth, MN.
W. B. Horning, and T. W. Neiheisel.
Archives of Environmental Contamination and Toxicology, Vol. 8, p. 545-552, 1979. 2 Tab, 11 Ref.

Descriptors: *Bioassay, *Minnows, *Copper, *Toxicity, Metals, Mortality, Growth Rates, Fish Reproduction, Fish Physiology, Lethal Limit, Spawning, *MATC.

A laboratory chronic toxicity test in which bluntnose minnows were exposed to copper in laboratory dilution water with a hardness of 200 mg/L as CaCO3 indicated that copper adversely affected fry survival, fry growth, and reproduction. The maximum acceptable toxicant concentration (MATC) for total copper based on reproductive impairment at 18.0 microg/L was between 4.3 (control concentration) and 18.0 microg/L. The 96-hr LC50 values from three acute toxicity tests ranged from 0.22 to 0.27 mg/L total copper with a mean value of 0.23 mg/L. The application factor (MATC/96-hr LC50) for bluntnose minnows and total copper was estimated to lie between 0.02 and 0.08. Bluntnose minnows held in control water for nine months ceased to spawn when they were exposed to 119.4 microg/L total copper. Fish exposed to 119.4 microg/L total copper for the same nine-month period began to spawn 60 days after being transferred to control water. (Deal-EIS).
W80-06277

CHANGES IN THE ULTRASTRUCTURE OF THE GILL EPITHELIUM OF PATELLA VULGATA AFTER EXPOSURE TO NORTH SEA CRUDE OIL AND DISPERSANTS,

Glasgow Univ. (Scotland). Dept. of Zoology.
M. A. Nuwayhid, P. S. Davies, and H. Y. Elder.
Journal of the Marine Biological Association of the United Kingdom, Vol 60, p 439-448, 1980. 1 Tab, 18 Ref.

Descriptors: *Oil, *Toxicity, *Detergents, *Animal pathology, Oil spills, Oil pollution, Mode of action, Cytological studies, Electron microscopy, Animal physiology, Water pollution effects, *Dispersants, *Crude oil, *Limpet, *Patella.

In order to investigate cellular damage associated with exposure to pollutants, the epithelia of the gills of Patella were examined after exposure to either sub-lethal concentrations or to sub-lethal durations of the water soluble fraction of North Sea crude oil and to the dispersants BP 100 X and BP 1100 WD. Lesions were found on parts of all gills at all concentrations used. Both crude oil and dispersants caused damage to surface microvilli and to cilia when viewed under the scanning electron microscope. Transmission electron microscopy revealed severe disruption of normal cellular organization, indicated in extreme cases by a great increase in the numbers of lysosomes, vacuolation of mitochondria and the extrusion of cytoplasm and damaged organelles throgh the apical surface. The difficulty of separating the primary effects due to the pollutant from secondary effects which are associated with the processes of cell death are discussed and some primary indicators, which might be suitable for the early diagnosis of pollution damage, are suggested. (Deal-EIS)
W80-06280

THE IMPACT OF OIL AND GAS PRODUCTION FROM THE MARINE ENVIRONMENT: AN ANALYSIS OF THE RECORD,
Union Oil Co. of California, Brea. Union Science and Technology Div.
R. J. Stegemeier.
In: Proceedings of Marine Sciences and Ocean Policy Symposium; A Definition of the Issues and a Search for a Consensus on Multiple Uses, held at Santa Barbara, CA in June 1979. p 221-233, 1979. 20 Fig, 24 Ref. University of California, Berkeley.

Descriptors: *Oil spills, *Water pollution effects, *Environmental effects, Transportation, Fishes, Shellfish, Resource management, Economics, Louisiana, Texas, *Outer Continental Shelf, Petroleum development, Economic impact.

The annual load of petroleum hydrocarbons which reach the sea comes from various petroleum sources. Transportation (tankers, etc.) is by far the worst offender with river and urban runoffs a close second. Spills from offshore oil production are almost insignificant. It is not well recognized that natural seeps put about 7.5 times more hydrocarbons into the seas than do spills from offshore oil production. The oceans also contain hydrocarbons that come from biogenic processes occurring in the sea and on the sea bottom. The recovery of polluted areas varies depending on the flushing of the polluted area, the type of sediment and the degree of isolation of its ecosystems and the kinds of organisms that form them. Oil lingers for different periods in different locations, and accordingly recovery times vary. A whole new area of scientific research, that related to oil spills, their effects, their fates, their clean-up and their prevention, has come into being during the past ten years. As a result of these efforts, improvements have been made in means for containing oil spills (except in high seas), less toxic dispersants, new efficient skimmers for taking oil off water surfaces, selection and development of suitable methods for cleaning beaches and last but not least, ways to minimize offshore oil spills. The offshore oil and gas industry has had substantial and favorable impacts on the economy of the coastal areas of Louisiana and Texas. It has had considerable impact on the financial condition of state and local governments. A summary comparison of impacts of OCS petroleum production versus oil imports is presented. (Sinha-OEIS).
W80-06313

OIL INTERACTIONS WITH FISHERIES,
Washington Univ., Seattle.
J. A. Crutchfield, Jr.
In: Proceedings of Marine Sciences and Ocean Policy Symposium; A Definition of the Issues and a Search for a Consensus on Multiple Uses, held at Santa Barbara, CA in June 1979. p 235-242, 1979. 20 Ref. University of California, Berkeley.

Descriptors: *Fisheries, *Oil pollution, *Oil spills, *Environmental effects, Resources development, Water pollution effects, Shellfish, Fish, Microorganisms, *Outer Continental Shelf, Petroleum development.

Fish and shellfish feeding on oil-tainted materials gradually build up hydrocarbons in the tissues, especially in the liver and gut. Though taste effects may be detectable for only a relatively short time, the marketing of contaminated products could cause a severe reaction among fish consumers. Since much of the actual or potential damage to fisheries from oil operations involves inshore waters, there is a real likelihood that recreational fishing may suffer. A number of reasonable firm policy conclusions emerge. First, for identifiable and quantifiable damages, full liability of the responsible party seems the appropriate remedy. Second, for specific, quantifiable damages for which no responsibility can be established, both equity and incentive would appear to favor a cooperative indemnification scheme with oil companies providing a repayment pool and with well-defined procedures for arbitration of claims. Third, there is urgent need for fast response capability in areas subject to high risk of oil spill, including immediate availability of biological assessment procedures and of personnel; activation of cleanup techniques; and advisory services to the fishing industry as to the limits within which the fishing must be curtailed. Finally, the need for national and international authority is emphasized to influence investment choices in the production, transportation, and transfer of oil at sea. (Sinha - OEIS).
W80-06314

RECENT STATE OF OIL POLLUTION IN THE MARICULTURE FARMS IN SETO INLAND SEA, JAPAN,
Kobe Univ. (Japan).
H. Hirose.
In: Proceedings of Marine Sciences and Ocean Policy Symposium; A Definition of the Issues and a Search for a Consensus on Multiple Uses, held at Santa Barbara, CA in June 1979. p 243-247, 1979. 4 Fig, 2 Tab. University of California Berkeley.

Descriptors: *Oil pollution, *Aquaculture, Water pollution effects, Resources development, Environmental effects, *Outer Continental Shelf, *Japan, Seto Inland Sea(Japan).

Oil pollution in Seto Inland Sea began to increase suddenly in the early '70s but is once again decreasing. Vessels such as freighters, tankers, motor-powered sailing boats and fising boats all cause oil pollution. From them come exhaust, dirty balance water, oil-tank washing water, bilge, sludge, all of which cause stationary oil pollution. Moreover, spills from accidents and collisions bring large scale, but temporary oil pollution. It is almost impossible to prevent accidents due to the outflow of oil. However, countermeasures to the accidents must always be prepared. The improvement of oil fences, oil-treatment chemicals and other ways must be devised. But the most important thing is to have the determination and enthusiasm to prevent the beginning of outflow of oil. (Sinha-OEIS)
W80-06315

THE USE OF BEST AVAILABLE AND SAFEST TECHNOLOGIES (BAST) DURING OIL AND GAS DRILLING AND PRODUCING OPERATIONS OF THE OUTER CONTINENTAL SHELF (OCS). PROGRAM FOR IMPLEMENTING SEC. 21(B) OCS LANDS ACT AMENDMENTS OF 1978,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 8B.
W80-06316

IMPACT OF DISCHARGE FROM POSSUM KINGDOM RESERVOIR (TEXAS) ON GENIC ADAPTATION IN AQUATIC ORGANISMS,
North Texas State Univ., Denton. Dept. of Biological Sciences.
E. G. Zimmerman, K. A. Anderson, and S. W. Calhoun.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-220270, Price codes: A05 in paper copy, A01 in microfiche. Project Completion Report, August 1980. 93 p, 16 Fig, 17 Tab, 63 Ref. OWRT B-227-TEX (1), 14-34-0001-9098.

Descriptors: Texas, *Brazos River(TX), *Possum Kingdom Reservoir(TX), North Central Texas, *Forage fish, *Water pollutioneffects, Water quality, Salinity, Nutrients, Reservoirs, Inflow, Water temperature, Discharge(water), Regulated flow, Regulated streams, Genetic adaptations, Aquatic organisms, Physiological adaptation.

Extensive river and stream regulation has occurred in the United States over the last several decades. A recent international symposium (Ward & Stanford 1979) reviewed the overall pattern of altered species composition and productivity caused by stream regulation. Construction of dams basically results in alteration of aquatic environments which influences biota for a considerable distance downstream from the impoundment (Spence & Hynes 1971a, 1971b; Hubbs & Pigg 1976; Young et al. 1976; Edwards 1978). The purpose of this study was to investigate the response of one component of the aquatic community, the forage fishes, to these conditions. Data concerning fish physiology and genetics above and below Possum Kingdom Reservoir and its relationship to the ecological modifications which have resulted from the impoundment have not been gathered prior to this study. The general focus of this study was to characterize differences in the forage fish communities, physiological response, and genetic alteration above and at several sites below the reservoir and attempt to relate the observed differences to physiological/behavioral responses of nonimpacted populations. Specific objectives of this study were to: (1) quantify changes in water quality which occur as a result of impoundment of the Brazos River; (2) characterize the forage fish fauna above and below the reservoir and relate any differences to alterations in habitat and/or water quality differences which have been manifested since completion of the dam; (3) determine physiological and behavioral responses of selected key species to variations in environmental salinity in an attempt to explain observed distributional patterns; and (4) examine physiological and genetic correlates of observed patterns among populations of N. lutrensis below Possum Kingdom Reservoir.
W80-06330

PROCESSES AFFECTING SEASONAL DISTRIBUTIONS OF WATER PROPERTIES IN THE SAN FRANCISCO BAY ESTUARINE SYSTEM,
Geological Survey, Menlo Park, CA, Water Resources Div.
For primary bibliographic entry see Field 2L.
W80-06336

DISTRIBUTIONS AND STABLE-ISOTOPE COMPOSITION OF CARBON IN SAN FRANCISCO BAY,
Geological Survey, Reston, VA, Geologic Div.
E. C. Spiker, and L. E. Schemel.
In: San Francisco Bay: The Urbanized Estuary: Proceedings of the Fifty-Eighth Annual Meeting of the Pacific Division/American Association for the Advancement of Science, held at San Francisco State University, San Francisco, CA, June 12-16, 1977: published by California Academy of Sciences, San Francisco. p 195-212, 1979, 11 Fig, 3 Tab, 56 Ref.

Descriptors: *Stable isotopes, *Carbon, *Carbon dioxide, *Bays, *Estuaries, Estuarine environment, Salinity, Alkalinity, Municipal wastes, Water pollution effects, Phytoplankton, Algae, Turbidity, Bottom sediments, *San Francisco Bay(CA).

Observed distributions of alkalinity, pCO2 and C-13 (sigma CO2) indicate that dissolved inorganic

carbon (DIC) was primarily supplied to San Francisco Bay by ocean, Delta, and municipal waste waters during the low Delta-outflow period from March 1976 to March 1977. Delta-derived alkalinity was typically about half that of ocean water and increased slightly with time. The pCO2 values were highest in the Sacramento River and southern boundary of South Bay and decreased to near-atmospheric values seaward of the Golden Gate. The C-13 (sigma CO2) was lowest in the Sacramento River, increasing to marine values in the Gulf of the Farallones. Golden Gate values were approximately 2 per mil less than those seaward, indicating that at least 10% of the sigma CO2 was biogenic and is apparently the product of respiration and the mineralization of organic matter in the Bay. South Bay alkalinity and pCO2 levels increased southward, whereas C-13 (sigma CO2) and salinity decreased. Municipal waste discharged into the South Bay is the most probable source of the excess biogenic CO2. Distributions of particulate organic carbon (POC) in North Bay were influenced by in situ phytoplankton production and seaward dilution of riverine and estuarine POC. Apparent depletions of pCO2 in North Bay coincide with chlorophyll a, POC, and C-13 (sigma CO2) increases. The C-13 (POC) values during March 1977 approached those predicted for in situ algal production, suggesting that about 80 to 90% of the POC was produced in the seaward part of the estuary. In situ algal production was an important source of POC in the river. However, in the null-zone associated turbidity maximum, less than two-thirds of the POC appears to be riverborne, the remaining one-third being produced in the estuary or associated with resuspended bottom sediment. South Bay suspended POC appears to be a mixture of resuspended bottom sediments, in situ produced POC and land-derived organic carbon. Based on C-13 data, Spartina salt-marsh grass does not appear to be a significant source of detritus in the Bay. The C-13 of sediment total organic carbon (TOC) indicates that riverine carbon from the Delta is diluted in the Bay by estuarine and marine carbon. The suspended POC and sediment TOC C-13 measurements approached marine values seaward of the Golden Gate. (USGS).
W80-06338

FLUCTUATIONS OF COPPER, ZINC, AND SILVER IN TELLENID CLAMS AS RELATED TO FRESHWATER DISCHARGE-SOUTH SAN FRANCISCO BAY,
Geological Survey, Menlo Park, CA, Water Resources Div.
S. N. Luoma, and D. J. Cain.
In: San Francisco Bay: The Urbanized Estuary: Proceedings of the Fifty-Eighth Annual Meeting of the Pacific Division/American Association for the Advancement of Science, held at San Francisco State University, San Francisco, CA, June 12-16, 1977; published by California Academy of Sciences, San Francisco, p 231-246, 1979, 8 Fig, 1 Tab, 27 Ref.

Descriptors: *Copper, *Zinc, *Clams, *Bays, *California, Freshwater, Estuarine environment, Water pollution effects, Heavy metals, Benthic fauna, *South San Francisco Bay(CA), *Macoma balthica, *Silver, San Francisco Bay.

Significant contamination of the tellenid clam Macoma balthica with copper and silver was observed at stations in South San Francisco Bay. The degree of contamination appeared to be greatly influenced by the discharge of freshwater into South Bay. Local runoff appeared to provide an important source of the contaminants, especially in the summer and fall. Freshwater discharge, either from local sources or from the Sacramento-San Joaquin Delta, also provided the force for the removal of biologically available copper and silver from South Bay, and the magnitude of the discharge appeared to determine the magnitude of annual peak in copper and silver concentrations in the clam. A metal-discharge index combining an indirect estimate of annual metal loading (derived from cumulative rainfall) with the inverse of freshwater discharge at the Delta was found to explain 60 to 80% of the temporal variance in the silver and copper concentrations in M. balthica. The index represents a first step toward quantitatively predicting the effect of any reduction in freshwater discharge into the Bay system on silver and copper enrichment in South Bay. Significant differences between temporal variations in zinc concentrations in the clams and the variations in copper and silver concentrations suggest that all trace contaminants do not behave similarly in South Bay. (USGS).
W80-06339

NATURAL AND ANTHROPOGENIC INFLUENCES ON BENTHIC COMMUNITY STRUCTURE IN SAN FRANCISCO BAY,
Geological Survey, Menlo Park, Ca. Geologic Div.

In: San Francisco Bay: The Urbanized Estuary: Proceedings of the Fifty-Eighth Annual Meeting of the Pacific Division/American Association for the Advancement of Science, held at San Francisco State University, San Francisco, California, June 12-16, 1977: published by California Academy of Sciences, San Francisco, p 409-426, 1979. 8 Fig, 56 Ref.

Descriptors: Environmental effects, *Benthos, *Bays, *California, Estuaries, Salinity, Distributions patterns, Bottom sediments, Seasonal, water-level fluctuations, Biomass, Waste disposal, Biota, Aquatic animals, Water pollution effects, San Francisco Bay(Calif).

Data collected in the San Francisco Bay estuary over the last 65 years show that numbers of macrofaunal species are greatest in the marine environment of the central region near San Francisco, decreasing toward the north and south. This distribution has traditionally been attributed to differences in absolute values of slinity and sediment texture. Recent studies of both the benthos and the physiocochemical environment near the substrate suggest that species distribution is more related to temporal variation in salinity and to intrmittent disturbance of bottom sediments by storm-generted and seasonal wind waves and by the seasonally alternating high and low river inflow. Physical disturbance of the substrate apparently contributes to a state of non-equilbrium in the benthic community especially in the shallow reaches: the community, dominated by colonizers, reflects an early stage of species succession. Some of the most successful species under these conditions are those introduced from other estuaries. Maximum values of toal benthic biomass, in contract to numbers of species, are fond in South Bay, probably reflecting reduced salinity variability, somewhat greater stability of subtidal sediments, and the larger quantities of potential food (high sewage-waste loadings, high concentrations of suspended particulate matter, and moderate to high standing stock of primary producers) resulting from shallow depth and the absence of strong water circulation. High biomass can also be attributed to the successful establishment of several large and abundant introduced species that thrive in South Bay. Although once apparent as a reduction of numbers os specis, the effect of waste disposal on the benthos is now often masked by natural perturbations resulting from biotic and abiotic disturbances of surficial sediments and by inhomogeneous distribution of the animals. Anthropogenic influencs on benthic community structure other than that resulting from the introduction of exotic species will become increasingly difficult to quantify and therefore to predict. Futures changes in the biota may be expected with continued reduction in fresh water flow into the estuary. (Kosco-USGS)
W80-06342

POTENTIAL HYDROLOGIC EFFECTS OF PEAT MINING IN THE RED LAKE PEATLANDS, NORTH-CENTRAL MINNESOTA--A PROJECT PLAN,
Geological Survey, St. Paul, MN. Water Resources Div.
D. I. Siegel.
Available from OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $1.25 in paper copy, $3.50 in microfiche. Geological Survey open-file report 79-1591, December 1979. 9 p, 2 Fig, 11 Ref.

Descriptors: *Environmental effects, *Peat, *Mining, *Water quality, *Minnesota, Streams, Fuels, Model studies, Simulation analysis, Water pollution effects, Surface waters, Groundwater, Evaluation, *North-central Minnesota, *Red Lake(MN), *Tamarac River(MN).

Peat is being considered for fuel in Minnesota. This study investigates the potential effects of large-scale surface mining of peat on the hydrology and water quality of Upper Red Lake and the Tamarac River. The major aspects of the study are the characterization of the surface-water and groundwater hydrology and water quality, including the trace-metal content of the peat. Data will be collected to construct two- and three-dimensional digital models to simulate the movement of ground water and its relation to surface water in the peatlands, streams, and lakes. After the model is calibrated with field data, it will be used to evaluate the effect of mining peat on the hydrology and water quality of the Upper Red Lake and Tamarac River. (USGS).
W80-06355

RESERVOIR EUTROPHICATION: FACTORS GOVERNING PRIMARY PRODUCTION,
Baylor Univ., Waco, TX. Dept. of Biology.
O. T. Lind, D. M. Trotter, L. Muschler, R. Neely, and J. Short.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-222201, Price codes: A04 in paper copy, A01 in microfiche. Completion Report, September 30, 1979. 61 p, 10 Fig, 14 Tab, 10 Ref. OWRT-B-210-TEX (1), 14-34-0001-7190.

Descriptors: *Eutrophication, *Reservoirs, *Phytoplankton, *Water quality, Physical properties, Chemical properties, Bioassay, On-site investigations, Algae, Phosphorus compounds, Nutrients, Fertilizers, Texas, Chlorophyll, Seasonal, Variability, Trophic level, Standing crops, Model studies, Productivity, Measurement, Water analysis, Water properties.

The physical and chemical factors which influence the eutrophication of the Waco and Sam Rayburn Reservoirs were investigated in this study during the period 1976/79. Field measurements were taken of the standing crop of phytoplankton and macrophytes and their rates of production. Selected physical and chemical factors thought to influence the phytoplankton production were measured and used to develop a model for the tropic states of the reservoirs. Frequently the rates of phytoplankton production were not governed by the biomass of phytoplankton present and therefore, governed more by physical factors such as surface light intensities and recycling of internal nutrient stores. The seasonal patterns of production tended to parallel the concentration of chlorophyll. Total phosphorus and chlorophyll concentrations were not highly correlated in the case of these reservoirs. The phosphorus nutrient-stimulation bioassay studies indicated that the North Bosque River is the major nutrient source for the Waco Reservoir. The production of algae blooms was highly variable depending on the nutrient loading and the annual maximum biomass of Elodea occurred in July. It is recommended that the trophic classification of reservoirs be based upon actual measurement rates of plant production. (Sidney-IPA).
W80-06367

HEALTH ASPECTS OF NITRATE ON DRINKING WATER AND POSSIBLE MEANS OF DENITRIFICATION (LITERATURE REVIEW),
National Inst. for Water Research, Pretoria (South Africa).
J. W. H. Adam.
Water SA (Pretoria), Vol 6, No 2, p 79-84, April 1980. 2 Tab, 33 Ref.

Descriptors: *Nitrites, *Nitrates, *Potable water, *Groundwater, Effects, Public health, Safety, Hazards, Diseases, Water quality, Water treatment, *Denitrification, Water purification, Solar distillation, Ion exchange, Vitamins, Economics, South Africa, South West Africa, Literature review.

The known effects of nitrate consumption on human health and the need and methods for deni-

trification of groundwater are discussed. The nitrate problem is acute in certain parts of South Africa and South West Africa and high exposures of nitrate to children can cause retarded body growth and slower reflexes. Nitrite, the reductase of nitrate, is known to cause a sometimes fatal blood disorder called methemoglobinaemia in infants under the age of six months. Vitamin C can prevent and treat methemoglobinaemia, but nitrate-rich drinking water containing nitrate in excess of 10 milligram per liter should be avoided. The chemical formation of nitrosamines by human gastric juice has been hypothesized and these N-nitroso compounds have exhibited possible carcinogenic, mutagenic, and teratogenic properties. Prolonged use by humans of high nitrate water may increase the chance of the formation of nitrosamines within the human body, so public water supplies should not contain more than 10 milligrams per liter nitrate. Solar distillation of water is an effective water treatment process on a small scale and for commercial scale operations, ion exchange seems to be the most effective and economical water purification process. (Sidney-IPA).
W80-06371

WATER QUALITY EFFECTS ASSOCIATED WITH IRRIGATION,
Kansas Water Resources Board, Topeka.
For primary bibliographic entry see Field 4B.
W80-06420

ECOLOGICAL STUDIES OF INTERTIDAL AND SHALLOW SUBTIDAL HABITATS IN LOWER COOK INLET.
Dames and Moore, Anchorage, AK.
In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for year ending March 1979. Vol IV, Receptors--Fish, Littoral, Benthos, p 1-275, October 1979. 37 Fig, 46 Tab, 40 Ref, Append. NOAA, Environmental Research Laboratories, Outer Continental Shelf Environmental Assessment Program, Boulder, CO.

Descriptors: *Habitats, *Ecosystems, *Environmental effects, *Biota, *Morphology, Resources development, Water pollution effects, Oil pollution, *Alaska, Baseline studies, *Outer Continental Shelf, Petroleum development, Cook Inlet, Ecological distribution, Environmental assessment.

Field studies were initiated in intertidal and shallow subtidal habitats in Lower Cook Inlet to examine species composition, zonation and seasonal patterns, trophic structure, rates of production and energy pathways. Habitats examined included rocky intertidal and subtidal areas, sand beaches and mud flats. The two major potential types of oil pollution of concern in Lower Cook Inlet are catastrophic spills of crude oil and chronic pollution by refined petroleum or refinery effluents. Chronic pollution is a concern chiefly on the eastern shore of the Inlet since most onshore facilities are planned for that side. A regional assessment of coastal morphology has been used to predict behavior of oil spills in Lower Cook Inlet and to develop a classification of the susceptibility of local coastal environments to oil spills. This classification is based primarily on geological features and sediment characteristics as they relate to interactions with crude oil. It provides a useful starting point in assessing potential impacts from oil pollution, but it is necessary to temper the assessments with the idea that the major incentive for investigating potential effects of oil pollution is protection of biological assemblages. A point sometimes overlooked is that a ranking of biological assemblages by either importance or susceptibility to oil pollution does not always agree closely with the classification based on geological characteristics. Several factors must be integrated to develop a satisfactory assessment of susceptibility. (Sinha-OEIS).
W80-06428

PELAGIC AND DEMERSAL FISH ASSESSMENT IN THE LOWER COOK INLET ESTUARY SYSTEM,
Alaska Dept. of Fish and Game, Kodiak.
J. E. Blackburn, and P. B. Jackson.
In: Environmental Assessment of the Alaskan Continental Shelf, Annual Reports of Principal Investigators for year ending March 1979. Vol IV, Receptors--Fish, Littoral, Benthos, p 276-288, October 1979. 1 Fig, 2 Tab, 9 Ref. NOAA, Environmental Research Laboratories, Outer Continental Shelf Environmental Assessment Program, Boulder, CO. NOAA-03-5-022-69.

Descriptors: *Fish, *Baseline studies, *Crabs, Environmental effects, Water pollution effects, Resources development, Oil pollution, *Alaska, *Outer Continental Shelf, *Ecological distribution, Finfish, Petroleum development, Cook Inlet, Estuarine fish.

This study is in part a survey of the nearshore finfish and commercial crab resources and food habits of lower Cook Inlet. The study is to evaluate the impact of oil development. Field collections and available data are to be drawn upon as source material. Field collections were collected primarily in the northern half of Kamishak Bay with some effort in Kachemak Bay in April and October of 1978. Specific objectives were to determine the feeding habits of principal life stages of dominant pelagic and demersal fish and provide an initial description of their role in the food web; describe the distribution and relative abundance of pelagic and demersal fish and their seasonal changes; identify areas of unusual abundance or of apparent importance to fish, especially commercially important species; review past information on the fisheries in lower Cook Inlet including commercial and sports catch statistics; define the geographical locations and seasonal use of spawning areas; identify the geographical and seasonal locations of important prey; and describe and evaluate the potential for impact on commercial, potentially commercial, and sports fisheries by OCS oil and gas explorations, development, and production. (Sinha-OEIS).
W80-06429

PELAGIC AND DEMERSAL FISH ASSESSMENT IN THE LOWER COOK INLET ESTUARY SYSTEM - APRIL 1976 - SEPTEMBER 1977,
Alaska Dept. of Fish and Game, Kodiak.
J. E. Blackburn.
In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for year ending March 1979. Vol IV, Receptors--Fish, Littoral, Benthos, p 289-446, October 1979. 41 Fig, 39 Tab, 42 Ref, 2 Append. NOAA, Environmental Research Laboratories, Outer Continental Shelf Environmental Assessment Program, Boulder, CO. NOAA-03-5-022-69.

Descriptors: *Fish, *Shellfish, *Temporal distribution, *Spatial distribution, *Baseline studies, Water pollution effects, Environmental effects, Resources development, Oil pollution, *Alaska, *Outer Continental Shelf, Cook Inlet, Petroleum development, Environmental assessment.

A total of 58 otter trawl hauls, 262 beach seine hauls, 215 surface tow net hauls, 18 purse seine hauls and 58 gill net sets were successfully completed in lower Cook Inlet during the summer of 1976 and 18 additional otter trawl hauls were completed during March 1977. A total of 23 families and 77 species of fish were identified in lower Cook Inlet. The study has produced a data base describing the fish species present, their relative abundance and several spatial and temporal distribution features. It has also provided growth rate, food habit and life history information for several fish species. The accumulated data should serve as a baseline for assessing the environmental impact of oil pollution from oil and gas exploration, development and finally the transport of oil cargoes. (Sinha-OEIS).
W80-06430

SHALLOW WATER FISH COMMUNITIES IN THE NORTHEASTERN GULF OF ALASKA: HABITAT EVALUATION, TEMPORAL AND SPATIAL DISTRIBUTION, RELATIVE ABUNDANCE AND TROPHIC INTERACTIONS,
Alaska Coastal Research, Homer.
R. J. Rosenthal.
In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for year ending March 1979. Vol IV, Receptors--Fish, Littoral, Benthos, p 447-455, October 1979. 1 Fig. NOAA, Environmental Research Laboratories, Outer Continental Shelf Environmental Assessment Program, Boulder, CO.

Descriptors: *Habitats, *Temporal distribution, *Spatial distribution, *Fish, *Water pollution effects, Baseline studies, Environmental effects, Resources development, *Alaska, *Outer Continental Shelf, Gulf of Alaska, Petroleum development, Trophic relationships, Environmental assessment.

Direct observations of fishes living in Hinchinbrook Entrance and Montague Strait were made during August-September 1978. The shallow water fish communities of this region are represented by at least 50 species which are typically found in the nearshore zone. Twenty-two percent (11/50) of the fishes identified to date were previously unreported in these waters, and as such represent northern range extensions in the eastern Pacific. During 1978, 2,790 square meters of sea floor were examined for fish density, and vertical distribution along randomly or haphazardly placed transects. Another 2,310 square meters of underwater terrain was surveyed within fixed transect bands. Additional qualitative data and natural history information, i.e. periods of reproduction, larval release time, etc., which are pertinent to a basic understanding of nearshore systems have also been recorded to aid in the assessment of the vulnerability of shallow water fish populations to both natural and man-induced perturbations in the northeastern Gulf of Alaska. (Sinha-OEIS).
W80-06431

SEASONAL COMPOSITION AND FOOD WEB RELATIONSHIPS OF MARINE ORGANISMS IN THE NEARSHORE ZONE,
National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
J. R. Dunn, A. W. Kendall, Jr., R. W. Wolotira, L. Quetin, and J. H. Bowerman.
In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for Year Ending March 1979. Vol IV, Receptors--Fish, Littoral, Benthos, p 456-528, October 1979. 43 Fig, 8 Tab, 25 Ref. NOAA, Environmental Research Laboratories, Outer Continental Shelf Environmental Assessment Program, Boulder, CO.

Descriptors: *Plankton, *Food webs, *Fish, Oil pollution, Water pollution effects, Resources development, Seasonal variations, Environmental effects, Baseline studies, *Alaska, *Outer Continental Shelf, Petroleum development, Kodiak Island, Nearshore zone.

A field program was designed to elucidate the distribution in time and space of the zooplankton (both holo- and meroplankton) of continental shelf waters contiguous to Kodiak Island. These planktonic forms are of vital importance to the marine food web of the area, not only as food for higher trophic levels, but because most finfish and shellfish of the area spend critical early parts of their life histories as members of the plankton community. Prior to this study, virtually nothing was known about the specific composition and abundance of the zooplankton community, nor was the seasonal occurrence and areal distribution of larval forms of species contributing to the fisheries of the area known. With the knowledge of these distributions, the effects of chronic or catastrophic impacts of petroleum development can be evaluated. Certain areas and seasons may be more critical than others to the success of year classes as they pass through their planktonic phase. (Sinha-OEIS).
W80-06432

SEASONAL COMPOSITION AND FOOD WEB RELATIONSHIPS OF MARINE ORGANISMS IN THE NEARSHORE ZONE OF KODIAK ISLAND--INCLUDING ICHTHYOPLANKTON, MEROPLANKTON (SHELLFISH), ZOOPLANKTON, AND FISH,

Washington Univ., Seattle. Fisheries Research Inst.
D. E. Rogers, D. J. Rabin, B. J. Rogers, K. Garrison, and M. Wangerin.
In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for year Ending March 1979. Vol IV, Receptors--Fish, Littoral, Benthos, p 529-662, October 1979. 16 Fig, 66 Tab, 15 Ref. NOAA, Environmental Research Laboratories, Outer Continental Shelf Environmental Assessment Program, Boulder, CO.

Descriptors: *Plankton, *Fish, *Food webs, *Seasonal variations, *Water pollution effects, Oil pollution, Food habits, Baseline studies, Environmental effects, Resources development, *Alaska, *Outer Continental Shelf, Petroleum development, Kodiak Island, Nearshore zone.

The general nature of this study relates to an examination of the zooplankton populations in the nearshore waters of the Kodiak Archipelago. The scope of the study consisted of intensive spring and summer sampling followed by less intensive autumn and winter sampling. The development of petroleum in Kodiak's marine environment may directly or indirectly affect the life processes of animals. Under natural conditions most animals are constrained, or limited to, for example, the time of year they may reproduce, the area over which the young may be distributed, and/or the depth(s) at which the larvae may breed. These constraints of time, space, and depth determine to a certain extent the mortality rate of larval forms of many fish species. It is also assumed that one of the problems of petroleum development is the potential introduction of a pollutant that may accentuate those natural constraints already in force. This study addresses the seasonal composition, spatial and temporal distribution of fish larvae to define the natural environmental limitations. With this information, the developmental processes of a species likely to be put under further constraint by an oil spill incident will be recognized. (Sinha-OEIS).
W80-06433

AN ASSESSMENT OF THE RECOVERY OF THE RED CEDAR RIVER AS A RESULT OF BEST PRACTICABLE POINT SOURCE POLLUTION CONTROL,
Michigan State Univ., East Lansing. Dept. of Zoology.
T. M. Burton.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-220379, Price code: A03 in paper copy, A01 in microfiche. Institute of Water Research, Michigan State University, Project Completion Report, August 1980. 31 p, 3 Fig, 4 Tab, 22 Ref. OWRT-A-099-MICH (1), 14-34-0001-9024.

Descriptors: *Point source pollution, *Periphyton, *Phosphorus, Primary production, *Nutrients, Nutrient loading, Streams, Water pollution sources, *Water pollution control, Water pollution treatment, Water recovery assessment, Red Cedar River(MI).

Studies conducted on the Red Cedar River, a warm-water, third order stream in south-central Michigan, in 1958-1962 and in 1978-1979 allow evaluation of alterations in sediment accrual rate, nutrient load, and primary production over a period of about 20 years. Total phosphorus input to the lower sections of the river basin have remained unchanged, so urbanization inputs have offset reductions in total phosphorus inputs resulting from upgrading domestic wastewater treatment from primary to tertiary. Total annual phosphorus discharge from the upper portion of this urbanizing basin has increased 2.4 fold over the period. However, discharge of phosphorus from the lower basin only increased 1.2 fold over 1959 values despite the increased upstream loading and 1.6 times more annual hydrologic discharge. Inorganic sediment accrual to the river bottom has been significantly reduced. Macrophyte productivity has declined markedly throughout the river. Periphyton production of organic matter has declined to about half of 1961 values for the entire river with this reduction occurring in the three downstream zones of the river. Nutrient loading is essentially the same from an upstream and downstream station indicating that nutrient input is derived more from diffuse sources at present. Changes observed during the past 20 years are especially related to human activities within the basin, changes in sewage treatment facilities and urbanization. These changes are documented in this paper.
W80-06437

5D. Waste Treatment Processes

ENTEROVIRUS INACTIVATION IN SURFACE WATER, GROUNDWATER, AND SOIL,
New Mexico State Univ., Las Cruces. Dept. of Biology.
R. T. O'Brien.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-211402, Price codes: A02 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, New Mexico State Univ. Technical Completion Report, July 1980. 16 p. OWRT A-052-NMEX(8), 14-34-0001-9033.

Descriptors: *Viruses, *Water pollution treatment, *Sewage treatment, Activated sludge, Temperature control, Septic tanks, Human wastes, Surface waters, Groundwater, Soils, *Virus inactivation, Polio virus.

This report summarizes the results of a long-term project on virus inactivation in the environment. Viral persistence in the water environment was highly variable. Viruses generally were inactivated more rapidly in surface water than in groundwater, while seawater was generally more virucidal than fresh water. Rates of virus inactivation were more rapid as water temperatures were increased. Experiments with radioactively-labeled virus indicate the primary mechanism of virus inactivation was damage to the genome. During the initial five hours of activated sludge treatment, most of the virus removal was due to adsorption to suspended solids. As treatment was continued beyond ten hours, the adsorbed viruses were inactivated. Ten percent of the viruses inoculated in the septic tank liquor were still infective after six days. Infective viruses were obtained in groundwater from observation wells, indicating that viruses remained infective for a sufficiently long time to contaminate groundwater. Viruses were distributed through the soil in all areas which were moistened with septic tank liquor. Viruses were shown to persist in the soil for extended periods of time. The dominant environmental factors influencing virus inactivation rates were soil temperature and soil moisture. There was a critical soil moistue threshhold at approximtely 3%, below which the rate of virus inactivation was accelerated.
W80-06201

CHARACTERIZATION OF WASTEWATER TREATMENT PLANT FINAL CLARIFIER PERFORMANCE,
Purdue Univ., Lafayette. Water Resources Research Center.
M. Tuntoolavest, E. Miller, and C. P. L. Grady, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-212657, Price codes: A06 in paper copy, A01 in microfiche. Technical Report No 129. June 1980. 118 p, 47 Fig, 21 Tab, 102 Ref, 2 Append. OWRT A-055-IND(1).

Descriptors: *Activated sludge system, *Wastewater treatment, *Aerobic treatment, Suspended solids(Mixed liquor), Solids retention time, Sludge recycle, Sludge treatment, Flocculation, Mathematical models, Pilot plants.

Because it determines effluent quality, the final settler is the critical component of an activated sludge system. In spite of this, a lack of data concerning the settling properties of activated sludge under various operational conditions has prevented the application of rational procedures to the design and operation of its clarification function. The research was conducted in the Purdue Activated Sludge Pilot Plant (PASPP) which was operated at a flow rate of 0.5 gpm and a constant solids retention time of 10 days utilizing a synthetic wastewater containing dry-moist dog food as the organic fraction. Three operational parameters (the mixed liquor suspended solids (MLSS) concentration in the aeration chamber, the air flow rate to that chamber, and the percent of sludge recycle from the settler to the aeration chamber) were studied and compared to two design parameters (the overflow rate and hydraulic retention time of the final settler). The MLSS Concentration was found to be the most important single factor governing the concentration of suspended solids in the effluent from the final settlers. For operation of a system at fixed retention time and overflow rate, stepwise regression analysis revealed that the product of MLSS concentration and the air flow rate exerted the strongest effect because 90% of the variability in the effluent suspended solids concentration could be accounted for by that term alone. When variations in the design parameters were considered as well, 87% of the changes in the independent variable could be accounted for by three terms: the MLSS concentration and its product with each of the design parameters. These results suggest that much more consideration should be given to the MLSS concentration in the design and operation of activated sludge final settlers.
W80-06220

THE UPTAKE OF FLUORIDES DURING COAGULATION,
Auburn Univ., AL. Dept. of Civil Engineering.
J. F. Judkins, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80 220619, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Institute. Auburn University, Completion Report, July 1980. 58 p 11 Fig, 7 Tab. OWRT A-043-ALA(3), 14-34-0001-7001.

Descriptors: *Fluorides, Alum, Rapid mix, *Water treatment, Sludge, *Water chemistry, *Chemical reactions, *Coagulation, Laboratory tests, Evaluations.

Turbid water samples of known turbidity, alkalinity and fluoride content, were coagulated with alum by the standard jar test procedure, and analyzed for residual fluoride and aluminum content. Greatest fluoride removal was found to occur at pH 6.5 and carryover aluminum concentrations were found to correspond directly to optimum alum dosage. It was found that the addition of fluoride to the rapid mix unit increased the amount of fluoride required to maintain in a given residual and increased the amount of alum required for coagulation. Sludge samples were placed in plastic bottles and stored in the laboratory. Supernatant from these bottles was collected at monthly intervals and over a five-month period the fluoride content of the supernatant was found to change very little. A method was developed to measure the fluoride content of coagulant sludge and verified by laboratory tests. The developed method was used to measure fluoride concentrations in sludges from selected water treatment plants.
W80-06263

AERATION OF WASTE IN SEPTIC TANK,
A. J. Smith.
U.S. Patent No 4,179,375, 5 p, 7 Fig, 15 Ref; Office Gazette of the United States Patent Office, Vol 989, No 3, p 1003-1004, December 18, 1979.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Sewage treatment, Septic tanks, Equipment, Aeration, Bubbles, Flow, Mixing.

An apparatus for use in an aerated sewage disposal system to aerate sewage waste in a septic tank comprises: (1) means including ducting to efect flow of waste from the tank, and to effect return flow of the waste to the tank; (2) other means to effect entry of oxidizing fluid into the waste flow; and (3) the first means including distributed outlet means in the tank to discharge the oxidizing fluid

in the form of small bubbles into the waste in the tank along with return of the flowing waste into the tank. The discharge into the tank causes a revolving flow of waste in the tank; and the outlet means may include a duct with a self-closing slit. (Sinha-OEIS)
W80-06272

CLOSED-CYCLE TEXTILE DYEING: FULL SCALE HYPERFILTRATION DEMONSTRATION (DESIGN),
La France Industries, SC.
C. A. Brandon.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80 181886, Price codes: A06 in paper copy, A01 in microfiche. Report No EPA-600/2-80-055, Environmental Protection Technology Series, March 1980. 99 p, 19 Fig, 14 Tab, 10 Ref, 3 Append. OWRT-0122, S805182.

Descriptors: *Water pollution control, *Separation techniques, *Membranes, *Dyes, *Textiles, *Filtration, *Recycling, Water quality, Organic compounds, Equipment, Installation, Economics, Optimization, Design, On-site investigations, Research and development, Conservation, South Carolina.

A full-scale demonstration of hyperfiltration for closed-cycle operations of a LaFrance Industries, SC, dye house is reported. Results from on-site pilot tests of three types of hyperfiltration modules are described for Phase I, the design phase. Hyperfiltration is a pressure driven membrane separation technique that was shown to be economical for recycle of energy, water, and chemicals by earlier research. About 50% of the energy used in wet processing can be saved by direct recycle of the permeate at full process temperature. The textile process, dye range, design, wash water composition, and economics of the system are described. Two dynamically formed zirconium oxidepolyacrylate membrane systems and one spiralwound poly (ether) amid membrane were tested. All gave permeate satisfactory for recycle and 96% of the wash water at 82 C was recovered as permeate for direct recycle as wash water. The unused dye pad liquor bypasses the membranes and is sent directly to the concentrate tank. Tests led to the selection of the Mott-Brandon ZOPA module for the demonstration operation phase. The payback period is estimated to be about 5.2 years without chemical recovery. Studies of concentrate and dye pad residual recovery will be initiated in the future. (Sidney-IPA).
W80-06273

DIELDRIN IN A RIVER CATCHMENT AND POTENTIAL METHODS OF REMOVAL,
Plymouth Polytechnic (England), Dept. of Environmental Sciences.
L. Brown, E. G. Bellinger, and J. P. Day.
Journal of the Institution of Water Engineers and Scientists, Vol 33, No 5, p 478-484, September 1979. 1 Fig, 7 Tab, 15 Ref.

Descriptors: *Water pollution, *Dieldrin, *watersheds(Basins), *Waste water treatment, Data collections, Surveys, Sediments, Water pollution sources, Foreign countries, Textiles, Chromium, Copper, Zinc, Manganese, Coagulation, Chemical analysis, Methodology, Peat, Activated carbon, Organic pesticides, *England, *River Holme.

Dieldrin, which is used for moth proofing in the textile industry, is likely to be present in the surface waters receiving waste discharges from this industry. Conventional treatment processes in sewage works do not significantly remove it. The River Holme catchment in Yorkshire is an area receiving such waste discharges. The river's water is soft having calcium and magnesium hardness rarely exceeding 20 mg/1. These soft waters are a prerequisite for a successful textile industry. The removal of dieldrin from some effluents in the River Holme catchment can be achieved using activated carbon. Although washed peat is not quite so effective it too can remove considerable quantities of dieldrin, about 0.3 mg/g peat. This figure may be a little conservative as Eye reported that the ultimate adsorptive capacity of peat was 0.7 mg/g. (Humphreys-ISWS)
W80-06283

REMOVAL OF INORGANIC POLLUTANTS FROM WASTEWATER DURING RECLAMATION FOR POTABLE REUSE,
National Inst. for Water Research, Pretoria (South Africa).
R. Smith, M. L. Siebert, and W. H. J. Hattingh.
Water SA (Pretoria), Vol 6, No 2, p 92-95, April 1980. 1 Fig, 2 Tab, 10 Ref.

Descriptors: *Waste water treatment, *Inorganic compounds, *Potable water, *Water reuse, Evaluation, Pilot plants, Water treatment, Disinfection, Neutralization, Sewage treatment, Recycling, Filtration, Chlorination, Activated carbon, Cadmium, Copper, Zinc, Mercury, Lead, Ammonia, Lime, Performance, Efficiencies, Cyanide, South Africa.

The ability of a pilot plant reclamation plant to remove certain toxic and aesthetically undesirable inorganic chemical constituents from purified sewage effluents is discussed. The multi-stage process of treatments was assessed at each stage as to its effectiveness in removing cadmium, copper, lead, mercury, zinc, and cyanide. The first stage in the reclamation process, 'high lime' treatment, removed 99.3% of the cadmium, 99.6% of the lead, 96% of the zinc, and 90% of the mercury. Ammonia stripping, secondary clarification, and sand filtration reduced the amount of cyanide by 19%, but removed little copper and mercury. Chlorination effectively removed the remainder of the cyanide and reduced the amount of copper to 10%. Activated carbon treatment in the last stage removed the remaining copper and mercury. The high lime and activated carbon treatment were the most effective treatments in the total process and concentrations of all six substances investigated were significantly reduced below the detection limits of the analytical methods used. (Sidney-IPA).
W80-06373

OZONATION AT THE STANDER WATER RECLAMATION PLANT,
National Inst. for Water Research, Pretoria (South Africa).
J. Van Leeuwen, and J. Prinsloo.
Water SA (Pretoria), Vol 6, No 2, p 96-102, April 1980. 3 Fig, 1 Tab, 23 Ref.

Descriptors: *Waste water treatment, *Ozone, *Oxidation, *Reclamation, Disinfection, Efficiencies, Chlorination, Lime, Activated carbon, Chemical oxygen demand, Biological treatment, Equipment, Economics, *South Africa.

The disinfection efficiency and economics of ozonation waste water treatment at the Stander Water Reclamation Plant, Pretoria, South Africa, are discussed. The ozone absorption system consists of a packed column (with redistributors) together with an injector mixing device and the unit gives ozone utilization efficiencies of 95% at a production rate of 10 milligram ozone per cubic decimeter of water. Ozonation was found to compliment chlorination for disinfection and both together provide a safety barrier which is lost when lime clarification is replaced by ferric chloride clarification. Disinfection of the waste water was satisfactory if total oxidant residuals were maintained at more than 0.2 milligram per cubic decimeter for 15 min. Ozonation lowers the chemical oxygen demand and total carbon concentration of water and also enhances their removal by active carbon. The useful life of the active carbon is significantly increased by ozonation since it probably lowers the load on the carbon and enhances biological growths on the carbon. The use of ozonation in water reclamation results in a net gain by reducing the cost of active carbon treatment. (Sidney-IPA).
W80-06374

5E. Ultimate Disposal Of Wastes

STREAMFLOW AND WATER QUALITY MODELING OF THE CHOWAN RIVER,
Virginia Polytechnic Inst. and State Univ., Blacksburg, VA. Dept. of Civil Engineering.
D. N. Contractor, and P. H. King.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-211261, Price codes: A04 in paper copy, A01 in microfiche. Virginia Water Resources Research Cener, Virginia Polytechnic Institute and State University. Bulletin 119, August 1980. 71 p, 29 Fig, 7 Tab, 34 Ref. OWRT B-074-VA(1).

Descriptors: Numerical modeling, *Algal growth, Water resources, Flood routing, *Model studies, *Numerical analysis, *Streamflow, *Water quality, Biochemical oxygen demand, Chemical oxygen demand, dissolved oxygen, Nitrogen compounds, *Algae, Chowan River(Va-NC), Implicit finite difference method.

This study investigated, by means of numerical simulation, the Chowan River system's water quality problems related to excessive algal growth. A computer program was developed to determine flow rates, velocities, and depths at 51 computer stations by routing flows through the river system. The output of this flow program provided the input for calculating the concentrations of biochemical oxygen demand (BOD), chemical oxygen demand (COD), dissolved oxygen (DO), and four nitrogen parameters (organic, ammonia, nitrite-nitrate, and algal) of each of the computer stations. The four nitrogen parameters were solved for simultaneously. Measured field data collected in 1974 were used to calibrate the model. the program was then used to simulate algal growth for 1974 and 1975 and was compared with measured data for verification of the program. The program was also used to study management strategies for water quality control. The first such plan was to measure the effects of reducing the concentration of nutrients from overland runoff on algal concentrations at the mouth of the rier. Another application of the program assumed the watershed to consist only of forests and nutrient runoff from the forests to be the river's only nonpoint source of pollution. this primeval condition resulted in roughly half the concentrations measured in 1974.
W80-06219

ASSESSMENT OF LAND TREATMENT TECHNOLOGY FOR PETROLEUM REFINERY SOLID WASTES,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
D. Pal, and M. R. Overcash.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-220593, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Institute, University of North Carolina, Raleigh, Rpt. No. 141, July 1980. 30 p, 2 fig, 6 tab. 14-34-0001-7173.

Descriptors: *Industrial wastes, *Oil industry, Waste characterization, Organic compounds, Soils, Soil types, *Waste disposal, *Ultimate disposal, *Solid wastes, *Land treatment, Petroleum wastes, Land application systems.

This report examines land treatment for the aggregate refinery solid wastes using representative constituent characteristics and site conditions. A major distinction is drawn between existing petroleum industry land farming and the site nondegradation approach of land treatment used in this report. The latter is more closely linked to the RCRA approach to hazardous waste management. The results of this study do not represent design criteria because of the highly critical need to test individual wastes and sites to be used before specification or permit approval of such systems. In addition to the evaluation of land treatment as an option for these total refinery solid wastes, a fundamental design procedure is presented. This procedure demonstrates the detailed levels of soil and waste analyses required to design any land application system. Successful long term performance and adherence to soil, food-chain, groundwater nondegradation constraints depend on utilizing an in-depth design procedure. Results of this study have demonstrated the differences attributable to soils, the waste parameters which are critical in design, and the potential savings associated with in-plant source control.

W80-06266

NUMERICAL MODELING OF LIQUID WASTE INJECTION INTO A TWO-PHASE FLUID SYSTEM,
Hawaii Univ., Honolulu. Water Resources Research Center.
S. W. Wheatcraft, and F. L. Peterson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80 213051, Price codes: A06 in paper copy, A01 in microfiche. Technical Report No 125, August 1979, 103 p., 21 Fig, 2 Tab. OWRT A-071-HI(3), 14-34-0001-7025, 7026, 8013.

Descriptors: *Liquid wastes, *Waste disposal, *Injection wells, Groundwater, Hydrodynamics, Dispersion, *Numerical analysis, Hawaii, *Path of pollutants, Groundwater movement, Coasts, *Sandbox model, Fluid transport equation, Convective dispersion equation.

The injection of liquid wastes into a groundwater environment saturated with density-stratified fluid is simulated by a finite-difference numerical model. The fluid transport equation is simultaneously solved with the convective-dispersion equation for salinity. The migration of the injected liquid waste effluent is then tracked by solving a second convective-dispersion equation for an ideal tracer dissolved in the effluent. The convective-dispersion equation for the ideal tracer is solved with the flow velocities obtained from the simultaneous solution of the fluid transport and the salinity convective-dispersion equations. The equations are solved for the two-dimensional case of a line of injection wells set close together parallel to the coastline. Total length of the line of injection wells is considered to be much longer than the distance to the ocean so that any vertical cross section taken normal to the coastline will appear the same. Results are presented in a time-series of contour maps in the vertical plane: one map for each time-step, with lines of equal concentration for the salinity (isochlors); and the effluent tracer (isopleths). The more concentrated effluent is found to migrate vertically upward around the injection well due to buoyant force, while dilute effluent solutions migrate horizontally, displaying very little buoyant rise.
W80-06318

POTENTIAL HEALTH HAZARDS ASSOCIATED WITH THE DISPOSAL OF SEWAGE SLUDGE ON AGRICULTURAL SOILS IN WESTERN OREGON,
Oregon State Univ., Corvallis, OR. Water Resources Research Inst.
C. Hagedorn.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-220387, Price code: A04 in paper copy, A01 in microfiche. Completion Report, June 1980. 67 p, 7 Fig, 16 Tab, 91 Ref. OWRT-B-048-ORE (2).

Descriptors: *Sludge disposal, *Sewage bacteria, *Public health, *Water quality, Safety, On-site investigations, Coliforms, Anaerobic digestion, Chemical degradation, Climates, Leaching, Movement, Path of pollutants, Groundwater, Surface waters, Percolation, Effects, Temperature, Water pollution, Subsurface drainage, Streptococcus, Waste treatment, Hazards, Oregon, Soils, Agricultural soils.

Field experiments were carried out to determine the extent of potential health hazards due to the persistence of fecal coliform bacteria in four Willamette Valley soils after application of anaerobically-digested sewage sludge. It was originally thought that the cool, wet, climate which occurs in the Willamette Valley over much of the fall, winter, and spring months would prolong the survival length of fecal bacteria so that ground and surface waters might be contaminated. Climatic data and coliform downward movement (through washing) were measured and no prolongation of fecal coliforms by the cool, moist winter weather was found. The fecal coliforms died off at roughly equal rates in all the four soils in the winter and more rapidly in the Dayton and Cloquato soils in the summer. Bacteria transport occurred down to 100 centimeters but declined to less than 20 cells per 100 milliliter by the fifth week and only a few cells reached perched water tables at two of the sites. The fecal streptococci were found to be unsuitable for reliable testing of bacterial levels from recent pollution in soil. It was concluded that sewage sludge application year-round is feasible and not a great health hazard if carried out properly. (Sidney-IPA).
W80-06368

AN APPROACH TO THE FRACTURE HYDROLOGY AT STRIPA: PRELIMINARY RESULTS,
University of Waterloo, Canada. Dept. of Earth Sciences.
J. E. Gale, and P. A. Witherspoon.
California Univ., Berkeley. Lawrence Berkeley Lab. Technical Information Report No 15, May 1979. 26 p, 13 Fig, 15 Ref.

Descriptors: *Radioactive waste disposal, *Fracture permeability, *Thermodynamics, Path of pollutants, radioisotopes, Fractures(geologic), Granite, Mapping, Core drilling, Boreholes, Logging(recording), Heat flow, Groundwater movement, Stress analysis.

Two main problems associated with radioactive waste storage in fractured crystalline rock are: (1) thermo-mechanical effects of waste heat generation and (2) the potential for transport of radioactive materials by groundwater. In both problems, fractures play a dominant role. In the first case, fractures have non-linear deformation characteristics that can modify the displacements induced by thermal loading. In the second case, matrix permeability and porosity of repository rocks are so low that fractures provide the only pathway for radionuclides to migrate away from the repository. Hence, it is essential to characterize the fracture system through a series of laboratory and field investigations. The complexity of the problem is illustrated by field studies in a fractured granite currently underway in an abandoned iron-ore mine at Stripa, Sweden. Field work required careful mapping of the fracture system, drilling boreholes approximately perpendicular to the principal fracture sets, oriented cores, detailed logging of fracture planes, injection tests to determine effective fracture aperature, and the integration of these data into a permeability tensor. A series of heater experiments attempted to determine how fluid pressure and permeabilities in fractured rock are affected by increasing temperatures. This involved the coupled problems of heat flow, fluid flow, and stress change. (Purdin-NWWA).
W80-06411

GROUND WATER MODELING IN SUBSURFACE NUCLEAR WASTE DISPOSAL -- AN OVERVIEW,
California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 5B.
W80-06434

EVALUATION METHODS FOR HYDROGEOLOGIC CONDITIONS AT RADIOACTIVE WASTE BURIAL SITES,
Waterloo Univ. (Ontario).
J. A. Cherry, P. Fritz, J. E. Gale, and R. W. Gillham.
Transactions American Nuclear Society, Vol 32, p 117-119, June 1979. 5 Ref.

Descriptors: *Fracture permeability, *Evaluation, *Aquifer testing, *Radioactive waste disposal, Diffusion, Advection, Dispersion, Fractures(Geologic), Shales, Igneous rocks, Boreholes, Injection, Groundwater movement, Radioisotopes.

Hydrogeologic criteria are a critical component in site-selection for subsurface storage or disposal of solid radioactive waste. Most sites have very low permeability. Methodologies for hydrogeologic studies of very low permeability environments are only in the early stages of development. Low ground water velocities at shallow depths occur in clayey and clayey silt deposits. The main potential mechanism of radionuclide migration is molecular diffusion rather than ground water advection. However, transport models must consider the combined results of advection and mechanical dispersion in fractures and molecular diffusion in the porous matrix. Shale and granite have low matrix permeabilities and porosities. However, fractures can provide higher rock mass permeability and porosity at specific sites. Four methods of measuring fracture permeability include: the use of double-packer assemblies combined with injection tests on single fractures and data on fracture geometry; drilling a central borehole with three peripheral boreholes parallel to three principal permeability axes and measuring the fluid pressures in the peripheral holes from multiple-packer injection tests; drilling orthogonal boreholes oriented with respect to the fracture system and testing the boreholes with increasing packer spacing; and the use of current testing and analysis techniques for high permeability zones in fractured shale. (Purdin-NWWA).
W80-06435

SOLID WASTE MANAGEMENT: DISPOSAL BY LANDFILL,
Johannesburg City Council (South Africa).
J. M. Ball.
Imiesa (Johannesburg), Vol 3, No 10, p 14-16, October 1978. 3 Fig.

Descriptors: *Landfills, *Solid wastes, *Waste disposal, Wastes, Waste dumps, Water pollution, Public health, Hydrogeology, Groundwater, Methane, Leachate, Moisture content, Water table, South Africa.

Sanitary landfill is a method of disposing of solid waste on land without causing a nuisance or hazard to the public health or safety. Refuse is confined to the smallest possible place and covered daily with a layer of earth in order to reduce odors, litter, and fire hazard. Possible long-term problems with this method of waste disposal are the formation of methane gas and leacheate formation. Methane generally escapes into the atmosphere without causing problems. The installation of gas venting systems and periodic checks for methane in buildings adjacent to the landfill are the only precautions to be taken. Leachate is formed by moisture input from precipitation or from groundwater encroachment. A hydrogeological investigation of the proposed landfill site can establish the high water table elevation. The site should be situated at least 1.5 meters above this level, and as far as possible from any surface water. Appropriate landfill cover material is mixtures of fine sands, silts and clays with permeabilities of between 10-3 and 10-6 cm/sec applied daily to a compacted thickness of 0.3 meters, with final cover up to 1.0 meter. Final levels should be contoured so that surface water drains off. (Stiles-IPA).
W80-06449

5F. Water Treatment and Quality Alteration

SURFACE-TREATED ACTIVATED CARBON FOR REMOVAL OF PHENOL FROM WATER,
Pennsylvania State Univ., University Park. Dept. of Materials Science.
O. P. Mahajan, C. Moreno-Castilla, and P. L. Walker, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-211139, Price codes: A03 in paper copy, A01 in microfiche. Institute for Research on Land and Water Resources, Pennsylvania State University Report, June 1980. 38 p, 10 Fig, 5 Tab, 25 Ref. OWRT A-050-PA(1). 14-34-0001-9040.

Descriptors: *Water purification, *Activated carbon, *Ion exchange, *Phenols, *Adsorption, *Resins, Oxidation, Carbon, Organic compounds, Water pollution sources, Separation techniques, Surfaces, Chelation, Heat treatment, *Potable water, *Ammonia.

The phenol adsorption characteristics of porous and non-porous carbons and ion-exchange resins were studied for possible removal of organics from drinking water. The nature of the carbon surface was the most important factor in phenol uptake on non-porous carbons at a given equilibrium concentration. Activated carbons which were oxidized with nitric acid, ammonium persulfate, or hydrogen peroxide gave decreased phenol uptake. The phenol adsorption increased however, if the chemisorbed oxygen was removed by heating in nitrogen gas. A greater increase could be realized if the activated carbons were heated in nitrogen gas at 950C to remove oxygen complexes on their surface. The phenol adsorption appeared to increase when more pi-electrons were available on the basal plane surfaces of the crystallites and reduced by oxygen complexes on edge sites. Water is probably attracted more strongly to the edge sites than is phenol. Activated carbons exhibited better phenol adsorption properties than commercial ion-exchange resins. (Sidney-IPA)
W80-06224

STEADY-STATE ESTIMATION OF COOLING POND PERFORMANCE,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
G. H. Jirka, and M. Watanabe.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY6, Technical Note, p 1116-1123, June 1980. 5 Fig, 5 Ref, 1 Append.

Descriptors: *Hydrothermal studies, *Water cooling, *Ponds, *Model studies, Estimating, Analytical techniques, Analysis, Mathematical models, Water temperature, Thermal stratification, Equation, Cooling ponds, Shallow ponds, Deep stratified ponds.

This note gave steady-state formulas and diagrams for the intake temperature for three types of cooling ponds: deep stratified cooling pond, shallow dispersive cooling pond, and shallow recirculating cooling pond. The models were simple but included the dominant heat transport mechanism in each case. The estimation of the model parameters as a function of pond design condition was similar to the procedure for the more detailed transient cooling pond models. The general use of these models will be for the estimation of average, such as monthly, performance conditions. The adequate averaging time was found to be in the order of the residence time of the cooling pond. (Humphreys-ISWS)
W80-06300

OPTIMUM MECHANICAL DRAFT WET COOLING TOWERS TO SUPPLEMENT ONCE-THROUGH COOLING AT SELECTED MISSOURI RIVER SITES,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
A. R. Giaquinta, and T. E. Croley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80 212764, Price codes: A03 in paper copy, A01 in microfiche. Report No 224, October, 1979. 44 p, 9 Fig, 2 Tab, 16 Ref. OWRT A-061-IA(1), 14-34-0001-8017.

Descriptors: *Cooling towers, *Optimization, *Economics, *Computer models, Computer programs, Mathematical models, Management, Water utilization, Thermal pollution, Equipment, Heated water, Water cooling, Powerplants, Hydrothermal studies, Heat transfer, Thermodynamics.

A complete, detailed analysis of wet tower/once-through hybrid cooling systems was carried out to give the most economical system arrangements and the optimum tower size for power plants on the Missouri River. To establish the design, performance, and cost of the optimum cooling system, a computer program was developed which gave the thermodynamic and economic performances of hybrid cooling systems. The objective was to maximize the permissible river heat assimilation capacity using different hybrid cooling system arrangements. The performance of the hybrid cooling system was found to depend upon the meteorological and hydrothermal conditions, the condenser flow rate, the size of the cooling tower, and the water consumption. The minimum total cost for three hybrid cooling system arrangements were determined in terms of the above parameters. The hybrid cooling systems were superior to once-through systems for some specific sites where the permissible heat assimilation capacity of the water was inadequate for dissipating all of the power plant waste heat. (Sidney-IPA).
W80-06325

5G. Water Quality Control

LAKE ERIE: A NEW PROGNOSIS,
Ohio State Univ., Columbus, Dept of Agronomy.
For primary bibliographic entry see Field 5B.
W80-06233

ALTERNATIVE CHOICES IN MEASUREMENT SYSTEMS FOR ARTIFICIAL RIVER AERATION,
Columbia Univ., New York.
N. M. Olgac, C. A. Cooper, and R. W. Longman.
Water Resources Research, Vol 16, No 3, p 583-591, June 1980. 3 Fig, 2 Tab, 28 Ref. NSF GK 37440.

Descriptors: *Aeration, *Rivers, *Water quality, *Measurement, *Model studies, Mathematical models, Oxygen, Dissolved oxygen, Biochemical oxygen demand, Carbon, Pollutants, Water pollution, Path of pollutants, Oxygenation, *Artificial aeration, Measurement systems.

Artificial in-stream aeration is an economical and, under appropriate conditions, desirable method for alleviating symptoms of water pollution in rivers. Some measurement of the degree of pollution is generally required for this and other aquatic reclamation applications. The objective of this paper was to optimize the selection of such measurements for use as feedback in aeration systems in order to improve performance under variable conditions. A special case of these mathematical results can also give the optimized measurement selection for water quality estimators. Two widely accepted measures of water quality are dissolved oxygen and biochemical oxygen demand, the latter being available only through time-consuming and rather inaccurate observations. This time delay can be avoided by correlating biochemical oxygen demand with measurements of total organic carbon but only with a further sacrifice of accuracy. The authors examined a hierarchy of feedback structures, which included the measurement of a variety of water quality parameters, and compared these structures to determine their relative performance. Finally, a trade-off between time lag and accuracy of biochemical oxygen demand measurements was developed to optimize performance. (Sims-ISWS).
W80-06394

WATER RESOURCES PLANNING

6A. Techniques Of Planning

WATER RESOURCES PLANNING: CONFLICT MANAGEMENT,
Policy Sciences Associates, Boulder, CO.
W. B. Lord.
Water Spectrum, Vol 12, No 3, p 1-11, Summer 1980. 5 Fig.

Descriptors: *Planning, *Water resources development, *Methodology, *Management, Project planning, Administration, Legislantion, Institutions, Multiple-purpose projects, Regional development, Social aspects, Comprehensive planning, Conservation, Political aspects, Alternate planning, Local governments, Federal government, Governmental interactions.

The institutional and political obstacles to effective conflict management of water resource planning are discussed. The decision-making structure does not expedite the resolution of water conflict and water resources development projects usually fall victim to distributive politics, a form of legislative 'mutual back-scratching' where strong local support makes individual projects attractive to legislators. Preauthorization planning does not contain enough detailed engineering design to fully evaluate the merits of a project. The more comprehensive the investigation, the more local opposition may be generated. Conflict avoidance at that stage usually involves appeasement of the opposition by add-ons like fish hatcheries and wildlife refuges, but these tactics may be limited by the lack of Federal money. Conflict situations may develop because of factual or technical questions, broad social goals to the pursued, or direct impacts of the projects (i. e. benefits and costs). Bargaining and the reliance on the scientific method can aid in the solution of the problem. The outlook for distributive planning is bleak and the number of conflicts will increase because the objective grounds for conflict are increasing. (Sidney-IPA)
W80-06232

A CASE STUDY IN THE IMPLEMENTATION OF THE FEDERAL WATER POLLUTION CONTROL ACT AMENDMENTS,
Scranton Univ . PA. of History and Political Science.
For primary bibliographic entry see Field 6E.
W80-06259

NUTRIENT MODELS FOR ENGINEERING MANAGEMENT OF PAMLICO ESTUARY, NORTH CAROLINA,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5A.
W80-06267

SPATIAL AND TEMPORAL AGGREGATION EFFECTS IN A REGIONAL WATER SUPPLY PLANNING MODEL,
Thayer School of Engineering, Hanover, NJ.
P. H. Kirshen.
Water Resources Research, Vol 16, No 3, p 457-464, June 1980. 2 Fig, 6 Tab, 8 Ref.

Descriptors: *Water supply, *Planning, *Model studies, *Africa, Mathematical models, Rainfall, Runoff, Storage, Aquifers, Rivers, Water demand, Irrigation, Livestock, Water resources, Simulation analysis, *Sahel-Sudan region.

In applying mathematical programing water supply planning models, water supplies and demands must be spatially and temporally aggregated. An assessment was made of the effects of aggregation on the results of a planning model for West Africa. The assessment used a detailed hydroeconomic simulation model to study the solution set of the planning model when it was applied to several representative subareas. Comparisons were made between the design reliability intended for the supply system and the actual reliabilities of sources as estimated by the detailed simulation model. Comparisons were also made between the system suggested by the planning model and the estimated least cost reliable system. (The least cost reliable system was found using a trial and error search method and the detailed simulation model.) It was found that the aggregation assumptions primarily affect the modeling of sources that depend directly on the highly variable precipitation (e.g., ephemeral aquifers). These sources should, in general, be excluded from the planning model and analyzed separately. Overall, unless a planner is particularly interested in studying the use of such unreliable sources, the spatial and temporal aggregation assumptions of the planning model do not hinder its use as an effective regional planning tool. (Sims-ISWS).
W80-06312

THE STATUS OF OPTIMIZATION MODELS FOR THE OPERATION OF MULTIRESERVOIR SYSTEMS WITH STOCHASTIC INFLOWS AND NONSEPARABLE BENEFITS,
Tennessee Univ., Knoxville, TN. Water Resources

Research Center.
R. E. Rosenthal.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80 220213, Price codes: A03 in paper copy, A01 in microfiche. Report No 75, May, 1980. 33 p, 1 Fig, 2 Tab, 116 Ref. OWRT A-052-TENNCD, 14-34-0001-8045.

Descriptors: *Water resource development, Planning, *Simulation analysis, Computer models, *Model studies, Optimization, Stochastic processes, *Mathematical models, Reservoirs, Reservoir operation, Inflow, Evaluation, Research and development, Operations research, Systems analysis, Benefits, Time series analysis, Bibliographies, Non-separability, *Multiple-purpose reservoirs.

A large number of reservoir management optimization models were assessed to aid in the planning and operation of water resource systems. Four characteristics that a management model should incorporate were indicated: multiple reservoirs (in arbitrary topological configuration), multiple time-periods, stochastic inflows, and nonseparable benefits. None of the 100 mathematical models found in the literature could effectively handle all of the four features and future models will probably have no greater success because of the incompatibility of stochastic inflows and nonseparable benefits. A model should be developed which handles three of the four characteristics effectively and then substitutes extensive sensitivity analysis capability for stochastic inflows and this method appears to be the best approach. It is recommended that there be a significant upgrading in deterministic, multireservoir, nonseparable-benefit models. (Sidney-IPA).
W80-06323

BACKWATER AT BRIDGES AND DENSELY WOODED FLOOD PLAINS, WEST FORK AMITE RIVER NEAR LIBERTY, MISSISSIPPI,
Geological Survey, Jackson, MS. Water Resources Div.
B. E. Colson, C. O. Ming, and G. J. Arcement.
Branch of Dist., USGS, 1200 S. Eads St., Arlington, VA 22202, Price $5.00. Geological Survey Hydrologic Investigations Atlas HA-598, 1979. 4 Sheets, 4 Fig, 2 Tab, 10 Ref.

Descriptors: Flood data, *Flood flow, Data collections, *Model studies, *Open channel flow, Streamflow, Peak discharge, Flood plains, Alabama, Louisiana, Mississippi, Flood profiles, *Bridges, *Backwater, Flow around objects, Streamflow forecasting, Analytical techniques, Vegetation, Embankments, Forest watersheds, Mannings equation, Digital computers, Evaluation, *West Fork Amite River(MS).

Floodflow data that will provide a base for evaluating digital models relating to open-channel flow were obtained at 22 sites on streams in Alabama, Louisiana, and Mississippi. Thirty-five floods were measured. Analysis of the data indicated methods currently in use would be inaccurate where densely vegetated flood plains are crossed by highway embankments and single-opening bridges. This atlas presents flood information at the site on West Fork Amite River near Liberty, MS. Water depths, velocities, and discharges through bridge openings on West Fork Amite River near Liberty, MS for floods of December 6, 1971, and March 25, 1973, are shown, together with peak water-surface elevations along embankments and along cross sections. Manning's roughness coefficient values in different parts of the flood plain are shown on maps, and flood-frequency relations are shown on a graph. (USGS).
W80-06348

BACKWATER AT BRIDGES AND DENSELY WOODED FLOOD PLAINS, THOMPSON CREEK NEAR CLARA, MISSISSIPPI,
Geological Survey, Jackson, MS. Water Resources Div.
B. E. Colson, C. O. Ming, and G. J. Arcement.
Available from the USGS, 1200 S. Eads St., Arlington, VA 22202, $3.75 in paper copy. Geological Survey Hydrologic Investigations Atlas HA-597, 1979. 3 Sheets, 3 Fig, 2 Tab, 10 Ref.

Descriptors: Flood data, *Flood flow, Data collections, *Model studies, Open channel flow, Streamflow, Peak discharge, *Flood plains, Alabama, Louisiana, Mississippi, Flood profiles, *Bridges, *Backwater, Flow around objects, Streamflow forecasting, Analytical techniques, Vegetation, Embankments, Forest watersheds, Mannings equation, Digital computers, Evaluation, *Thompson Creek(MS), Wooded flood plains.

Floodflow data that will provide a base for evaluating digital models relating to open-channel flow were obtained at 22 sites on streams in Alabama, Louisiana, and Mississippi. Thirty-five floods were measured. Analysis of the data indicated methods currently in use would be inaccurate where densely vegetated flood plains are crossed by highway embankments and single-opening bridges. This atlas presents flood information at the site on Thompson Creek near Clara, MS: Water depths, velocities, and discharges through bridge openings on Thompson Creek near Clara, MS, for flood of March 3, 1971, are shown, together with peak water-surface elevations along embankments and along cross sections. Manning's roughness coefficient values in different parts of the flood plain are shown on maps, and flood-frequency relations are shown on a graph. (USGS).
W80-06353

CENTRAL ARIZONA PROJECT: OPERATIONS MODEL,
California Univ., Los Angeles. School of Engineering and Applied Science.
W. W-G. Yeh, L. Becker, D. Toy, and A. L. Graves.
Journal of the Water Resources Planning and Management Division, American Society of Civil Engineers, Vol 106, No WR2, Proceedings Paper 15573, p 521-540, July 1980. 7 Fig, 3 Tab, 9 Ref, 3 Append.

Descriptors: *Water management(Applied), *Arizona, *Model studies, *Aqueducts, *Decision making, Water resources, Discharge(Water), Pumping, Computer models, Mathematical models, Planning, Linear programming, Optimization, Hydraulics, Water supply, Methodology, Steady flow, Unsteady flow, Operations research, Water conveyance, Central Arizona Project, Granite Reef Aqueduct.

An optimization model was developed to determine operating policies for the Granite Reef Aqueduct of the Central Arizona Project CAP with the objective of minimizing the on-peak hour pumping while meeting downstream delivery and constraints. The section of aqueduct considered for optimization contains 4 pumping stations, 4 inverted siphons, 2 turnouts, 13 check structures, and 19 pools. Pump schedules and gate positions and flows were determined on the basis of a steady state, linearized analysis of the hydraulics at 2 hr intervals for a week. A transient analysis was carried out for the purposes of: (1) verifying the linearized analysis, (2) determining the intrahour transient generated by pumping and gate motions, and (3) obtaining suitable gate motions that are functions of time. Linear programming was used for the optimization with decomposition in time and along the aqueduct length. An iteration and updating procedure was used to reduce linearization errors. Transients were found to be appreciable for rapid and large flow changes. Level errors were found to be reasonable, but periodic level updating would probably be required. (Humphreys-ISWS).
W80-06385

ORGANIZING TO COPE WITH HAZARDOUS MATERIAL SPILLS,
Ryckman's Emergency Action, St. Louis, MO.
For primary bibliographic entry see Field 5B.
W80-06419

6B. Evaluation Process

EFFLUENT FEES, AN ALTERNATIVE SYSTEM FOR ACHIEVING WATER QUALITY STANDARD IN ALABAMA-PILOT STUDY,
Auburn Univ., AL. Dept. of Economics.
A. N. Link, F. A. Scott, and E. M. Galvin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80 219694, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Institute . Auburn University. Technical Completion Report, July 1980. 19 p 3 Tab. OWRT A074-ALA(1), 14-34-0001-9001.

Descriptors: *Federal Water Pollution Control Act, Effluents, Permit system, Fee system, *Costs, *Alabama, Pilot study, Black Warrier River(AL), Evaluation.

The 1972 and 1977 Amendments to the 1948 Federal Water Pollution Control Act authorized the government to set national standards for effluent discharges and water quality. Enforcement of these standards was delegated to the individual states. Alabama applies and enforces these standards to all point source polluters through a permit system of fixed uniform standards. But no consideration has been given to the cost that each polluter incurs in meeting these uniform standards; consequently, the level of pollution abatement is not attained at the minimum cost to society. An alternative to the uniform standards system is an effluent free system. We evaluate such a system in this study using as a test case a portion of the Black Warrior River. Our empirical analysis of this river segment suggests that there would be a 6 percent reduction in cost under the effluent fee system compared to the cost of the existing system of uniform standards.
W80-06264

A SURVEY AND EVALUATION OF CULTURAL RESOURCES: PHASE II OF THE OROVILLE-TONASKET UNIT EXTENSION,
Oregon State University, Corvallis. Dept. of Anthropology.
S. L. Snyder, and W. D. Honey.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-198476, Price Codes: A02 in paper copy, A01 in microfiche. Report, April, 1980. 23 p, 7 Fig, 1 Tab, 8 Ref, 1 Append. 8-07-01-S0079.

Descriptors: *Archaeology, *Irrigation effects, *Evaluation, Surveys, Inspection, Mapping, History, Irrigation design, Washington, Cultural resources, Irrigation systems, *Oroville-Tonasket irrigation extension(WA).

A cultural resource survey to identify prehistoric and historic sites, structures, and objects along the proposed Phase II Oroville-Tonasket Unit Extension irrigation system was carried out by members of the Department of Anthropology, Oregon State University. Field reconnaissance of the area was carried out on foot and by vehicle along the 29 route miles at a rate of about 4.4 miles per day per individual. Literature, records, and conversations with residents indicated few artifact discoveries in the area. No archaeological historic sites were revealed by this investigation, but excavation during construction of the irrigation system may expose more cultural materials. It was recommended that Phase II of the project proceed as scheduled. (Sidney-IPA)
W80-06284

CONSOLIDATION OF IRRIGATION SYSTEMS: PHASE II ENGINEERING, ECONOMIC, LEGAL, AND SOCIOLOGICAL REQUIREMENTS,
Colorado State Univ., Fort Collins. Dept. of Sociology.
E. C. Vlachos, P. C. Huszar, G. E. Radosevich, and G. V. Skogerboe.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80 217300, Price codes: A16 in paper copy, A01 in microfiche. Colorado Water Resources Research Institute, Colorado State University Completion Report No 94, May 1980. 366 p, 33 Fig, 47 Tab, 280 Ref, 2 Append. OWRT-B-083-COLO(10).

Descriptors: *Irrigation systems, *Consolidation, *Environmental effects, *Legal aspects, *Social aspects, Evaluation, Management, Networks, Regu-

lation, Irrigation design, Colorado, Wyoming, Nevada, Arizona, Irrigation engineering, Water distribution (Applied), Water management (Applied), Efficiencies, Equity, Benefits, Decision making.

The physical, social, legal, political, and economic factors involved in the consolidation or irrigation systems are discussed. Phase I of the consolidation pln emphasized the general description of eight irrigation systems and the theoretical framework for the implementation of the consolidation is considered in Phase II. The conditions in the Poudre and Grand Valleys, Colorado; Ashley and Utah Valleys, Utah; Eden and Riverton Valleys, Wyoming; the Truckee-Carson Irrigation District in Nevada; and the Salt River Valley in Arizona were compared and evaluated for future consolidation. The planning process is greatly influenced by community environment and culture, local organization structure and network, and the perception of the benefits and the alternatives to consolidation. The regional coordination of a project is extremely important in order to provide efficiency, equity, and effectiveness in the consolidation process. Conservation rather than further development of water resources is a major concern and efficient, rather than excessive, water use should be encouraged. More coordinating powers and interdisciplinary integration by decision makers are recommended. (Sidney-IPA)
W80-06321

PUBLIC PARTICIPATION IN STATEWIDE 208 WATER QUALITY PLANNING IN NORTH CAROLINA: AN EVALUATION,
North Carolina Univ. at Chapel Hill. Dept. of City and Regional Planning.
D. R. Godschalk, and B. Stiftel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-220197, Price codes: A08 in paper copy, A01 in microfiche. Water Resources Research Institute, University of North Carolina, Raleigh, Report No 155, May 1980. 165 p, 26 Fig, 80 Ref. OWRT-A-096-NC (3), 14-34-0001-9035.

Descriptors: *Water quality, *Planning, Public Involvement, Citizen involvement, Evaluation, Nonpoint source program, Public participation, *North Carolina, *Public surveys, North Carolina 208 Program.

The public participation effort of the North Carolina statewide water quality planning program is evaluated based upon a model of public participation in planning as an exchange process with three arenas: opportunities, information, and response. Data for the evaluation were collected through field observation of participation events, personal interviews with agency staff, and a two-wave mail survey of participants. The participation program actively involved 1,600 persons in ninety-four meetings over a two-and-one-half year period, and cost approximately six percent of the planning budget. Participants were above state averages for all measures of socio-economic status used, were overwhelmingly male and white, and chiefly represented government, business, and farm interests. Participants were given opportunities to comment on most of the major decisions of the planning process, but not all because planners could not always identify significant decisions before the fact. In addition, opportunities were not always well publicized. A large number of staff had direct contact with participants, but those who did not were poorly informed about participant opinion. Six of the twelve major decisions of the planning process were substantially influenced by participation. Participants agree with fifty of the seventy-six plan recommendations. The evaluation concludes that the North Carolina 208 program was opened widely to citizens and that their participation significantly influenced the statewide 208 plan.
W80-06332

CASE STUDY ON WATERLOGGING AND SALINITY PROBLEMS IN PAKISTAN,
National Engineering Services, Lahore (Pakistan).
For primary bibliographic entry see Field 4B.
W80-06412

GROUND WATER HEAT PUMPS IN WISCONSIN,
Geological Survey, Madison, WI.
For primary bibliographic entry see Field 8C.
W80-06423

NETWORK FLOW OPTIMIZATION FOR WATER RESOURCES PLANNING WITH UNCERTAINTIES IN SUPPLY AND DEMAND,
Texas Univ. at Austin. Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 4A.
W80-06436

6D. Water Demand

MONTANA WATER RIGHTS - A NEW OPPORTUNITY,
Montana Univ., Missoula.
For primary bibliographic entry see Field 6E.
W80-06256

SPATIAL AND TEMPORAL AGGREGATION EFFECTS IN A REGIONAL WATER SUPPLY PLANNING MODEL,
Thayer School of Engineering, Hanover, NJ.
For primary bibliographic entry see Field 6A.
W80-06312

WATER RESOURCES OF THE MARQUETTE IRON RANGE AREA, MARQUETTE COUNTY, MICHIGAN,
Geological Survey, Lansing, MI. Water Resources Div.
N. G. Grannemann.
Available from OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $11.25 in paper copy, $3.50 in microfiche. Geological Survey open-file report 79-1339, 1979. 77 p, 34 Fig, 20 Tab, 23 Ref.

Descriptors: *Water supply, *Surface water availability, Water demand, *Streams, *Lakes, Mining, Water storage, Glacial drift, Aquifers, Groundwater, Flow characteristics, Water quality, Water analysis, Hydrologic data, Michigan, *Marquette Iron Range area(MI), Marquette County(MI).

Dependable water supplies are vital to the mining industry in the Marquette Iron Range in Michigan. Development of processes that concentrate and pelletize low-grade iron ore has permitted mining to expand during the past two decades. Water demand has increased both for iron ore concentration processes and for the area's general development. Five main streams drain the area. Their total average annual discharge is about 700 cu ft/sec, of which, about 150 cu ft/sec is inflow from outside of this study's limits. The Middle Branch and East Branch Escanaba River flow through the central part of the study area and drain about 60 percent of it. The combined natural flow of these two streams equals or exceeds 100 cu ft/sec 90 percent of the time. Median annual 7-day low-flows are about 0.25 cu ft/sec per sq mi in most of the area. Seven stream impoundments and 243 natural lakes provide surface water storage. Surface water is generally of a calcium-magnesium bicarbonate type and dissolved-solids concentrations are generally less than 150 mg/L. Small streams that drain glacial outwash deposits have higher dissolved-solids concentrations than larger streams. Large groundwater supplies may be developed from glacial outwash aquifers along the northern, southern, and eastern boundaries of the study area. Thin, unconsolidated deposits of low permeability occur in the center of the area. Metamorphosed bedrock produces moderate amounts of water only in fracture zones. Sandstones in the eastern part of the area yield water at some locations, but these deposits are seldom utilized because other ground-water sources are more readily available. Ground water in the Marquette Iron Range is generally of suitable quality for most uses. Iron concentrations, however, are frequently high. (USGS).
W80-06351

CENTRAL ARIZONA PROJECT: OPERATIONS MODEL,
California Univ., Los Angeles. School of Engineering and Applied Science.
For primary bibliographic entry see Field 6A.
W80-06385

DYNAMIC MODELS OF RESIDENTIAL WATER DEMAND,
Saint Mary's Univ., San Antonio, TX. Dept. of Economics.
D. E. Agthe, and R. B. Billings.
Water Resources Research, Vol 16, No 3, p 476-480, June 1980. 2 Tab, 15 Ref.

Descriptors: *Water demand, *Cities, *Arizona, *Model studies, Mathematical models, Costs, Prices, Weather, Evaporation, Evapotranspiration, Municipal water, Income, Analytical techniques, Water supply, *Tucson(AZ).

Static, Fisher-Kaysen, Koyck, flow adjustment (Bergstrom), and stock adjustment econometric models of the demand for residential water were tested for their ability to explain the monthly residential demand for water in Tucson. Marginal price and a second price-related variable were used in the estimating equations to account for block rates and fixed charges in the water rate schedule. The other independent variables were household income and evapotranspiration minus rainfall. The Fisher-Kaysen model produced very poor statistical results. The estimated long-run marginal price elasticities of demand varied from -0.266 to -0.705. The short-run marginal price elasticity estimates varied from -0.179 to -0.358 except for the linear flow adjustment model with a value of -2.226. This unexpected result casts some doubt on the applicability of the flow adjustment model to estimating the price elesticity of demand with monthly data. (Sims-ISWS).
W80-06403

6E. Water Law and Institutions

IDENTIFICATION OF TRAINING NEEDS FOR PUBLIC PARTICIPATION RESPONSIBILITIES,
Massachusetts Univ., Amherst. Water Resources Research Center.
M. O. Ertel.
Water Resources Bulletin, Vol 16, No 2, p 300-304, April 1980. OWRT B-063-MASS(2).

Descriptors: *Planning, *Training, *Public participation, *Water resources, *Coasts, Management, Programs, Project purposes, *New England, 208 programs.

The research project reported here surveyed planners in Coastal Zone Management and '208' programs in New England to determine the nature of their educational and experimental preparation for carrying out public participation functions, and to identify the planners' own perceptions of the relative importance of those functions and their adequacy for performing them. Criteria for effective programming were developed and used as a standard for comparing various backgrounds with capability for performing necessary tasks. The research indicates that prior planning experience is more directly related to perceived adequacy than either academic or other experiential backgrounds. The survey also revealed a predominant emphasis on activities involving direct public conduct, e.g., organizing citizen advisory groups and conducting public meetings. The results of the analysis were used to make recommendations for curriculum topics that should be incorporated into the training of professional planners so that they will be better prepared to undertake public participation responsibilities. Those recommendations stress preparation for direct public contact, but also for training in other means of public involvement, such as media contact, that are now being carried out with comparable emphasis or effectiveness.
W80-06255

MONTANA WATER RIGHTS - A NEW OPPORTUNITY,
Montana Univ., Missoula.

A. W. Stone.
Montana Law Review, Vol 34, No 1, p 57-74, Winter 1973. OWRT A-051-MONT(2).

Descriptors: *Montana, *Water rights, *Water allocation(Policy), Legislation, Water law, Constitutional law, State governments, Administrative agencies, Water resources, Judicial decisions.

Montana's new constitution provides that all existing rights to the water use for any useful or beneficial purpose are recognized confirmed. Under Montana's present mix of water laws, individuals bring their disputes to a court. The court renders a decree stating the rights of the parties to the suit only, not settling the rights of later challengers. In the past, the Montana legislature hs done very little to assist the courts. Therefore, decrees are neither permanent nor conclusive, and rights are neither clear nor secure. Montana has three codified methods of adjudicating water rights: (1) the State Engineer may bring actions to adjudicate stream rights, but these code sections have never been implemented; (2) the State Water Conservation Board may adjudicate rights to its sources of supply; and (3) more frequently used is a provision authorizing private litigation over water rights. There must be a conclusve ascertainmet of existing rights. Future water rights should be acquired by permit and administered as an administrative, not a judicial task. (Wilson-Florida).
W80-06256

A CASE STUDY IN THE IMPLEMENTATION OF THE FEDERAL WATER POLLUTION CONTROL ACT AMENDMENTS,
Scranton Univ . PA. of History and Political Science.
L. Champney.
Water Resources Bulletin, Vol 15, No 6, p 1602-1607, December 1979. 11 Ref. OWRT-A-054-NJ(2), 14-34-0001-8032.

Descriptors: *Federal Water Pollution Control Act Amendments, *Water quality, *Policy, *208 planning, *Legislation, *Administration, Institutional constraints, Water Quality Act, Water pollution, Political aspects, Institutions, Regulation, Non-point source pollution, Water pollution sources, Models.

The author presents a model of the policy implemetation process useful for examination of the way PL 92-500, the Federal Water Pollution Control Act Amendments, are being implemented on an arewide basis. Variables in the model include availabe resources, characteristics of implementing agencies, disposition of the implementors and the political and socioeconomic environment of the process. The model was used to study four '208 areas' in the New York-Philadelphia corridor: the Lower Raritan-Middlesex County area of NJ, the Mercer County of NJ, the Tri-County area in Southern NJ, and the multicounty Southeastern PA area. Each of these areas displays an urban-rural mix with large proportions of high population-density residential, commercial, and industrial tracts. The most severe water problems for each area are non-point sources o pollution originating from urban runoff and construction activity. The model draws attention to variables which may interact in a variety of ways of affect the impact of implementation efforts on desired outcomes in a particular policy sphere. The differing political and socioeconomic conditions appear to be the primary influences in these relationships in the case of PL 92-500. This model displays the fact that the manner in which PL 92-500 is being implemented on an areawide basis results in profoundly different institutional outcomes in similar geographic areas. (Iervolino-NC)
W80-06259

GROUNDWATER LAW IN VERMONT: PLANNING FOR UNCERTAINTY, PLURALISM AND CONFLICT,
Vermont Law School, Royalton. Environmental Law Center.
R. O. Brooks.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80 220601, Price codes: A10 in paper copy, A01 in microfiche. Vermont Water Resources Research Center, University of Vermont, Burlington, Technical Completion Report, January 1980. J. Stephen Dycus, editor. 189 p, 79 Ref. OWRT A-040-VT(1), 14-34-001-9042.

Descriptors: *Groundwater, *Groundwater management, *Groundwater availability, *Water law, Hydrology, Planning, Economic impact, Surface groundwater relationships, *Aquifer management, *Vermont, *Riparianism, New England, Federal Water Pollution Control Act, Water rights, Groundwater Regulation.

In recent years, relatively little has been done in Vermont to protect or allocate groundwater supplies. As these resources become increasingly more polluted and scarce, there is an urgent need for effective management. This need is aggrevated by four major problems: (1) the lack of basic, centralized data regarding groundwater supplies and quality; (2) the pluralism of agencies, laws, and policies dealing with aspects of groundwater; (3) the lack of a strong public perception that a serious problem exists and (4) no apparent consensus on principles of allocation of groundwater. In attempts to address these problems, researchers at the Vermont Law School and the Vermont University sponsored a conference on groundwater law in June 1978. The discussions focused on surveying the groundwater situation and problems; inventorying existing laws; and examining alternative state approaches to managing groundwater. The outcome of the conference developed recommendations for formulating a rational management plan reflecting the broadest public interest. Specific needs of high priority were identified which include: (1) information about incidence and quality of groundwater supplies which should be communicated to the public and lawmakers; (2) a system of public administration of groundwater use, recognizing the interconnection between groundwater users. With careful attention given to these priorities, the establishment of a sensible management plan will ensure high quality water supplies for future generations in Vermont.
W80-06260

THE ADMINISTRATION OF REGULATION: PERMIT AND LICENSING ACTIVITIES FOR WATER RESOURCE MANAGEMENT IN NEW YORK AND NEW JERSEY,
New York Univ., NY. Public Policy Research Inst.
R. Zimmerman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80 223647, Price codes: A11 in paper copy, A01 in microfiche. Report, April 30, 1980. 230 p, 14 Fig, 22 Tab, 78 Ref, 3 Append. OWRT-C-80090-PC(No 8405)(1), 14-34-0001-8405.

Descriptors: *Permits, *Administration, Evaluation, *Model studies, Coordination, Institutional constraints, *Water management (Applied), Legal aspects, Legislation, Political aspects, Federal jurisdiction, State governments, *New York, *New Jersey, Decision making, Efficiencies, Water policy.

The administrative problems created by the use of permits and licenses as a means of managing the effects of man-made changes on the environment is addressed in this study. Emphasis is placed on the managerial and organizational processes that support the permitting process and the effectiveness of these organizational designs in dealing with both the public and private sectors. The study concentrates on the administrative problems in the heavily industrialized and populated areas of New York and New Jersey. Possible simplified managerial arrangements and permit systems are examined and the benefits and costs are analyzed. The reasons for the proliferation of permits and the organizational systems which fostered these changes are examined on the State level. The Federal environmental policies are seen only as partial constraints on any existing or new permitting system. A new model for permit administration is outlined which includes initial process and procedures, routing of relevant applications, and the appeals procedure. Another model based on modifications of existing systems is also proposed and the system of intergovernmental relationships is discussed. (Sidney-IPA).
W80-06320

THE RELATIONSHIP OF ALABAMA WATER LAW TO WATER CONSERVATION AND THE DEVELOPMENT OF ENERGY RESOURCES,
Alabama Univ., University. School of Law.
H. Cohen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80 213028, Price codes: A08 in paper copy, A01 in microfiche. Completion Report, June, 1980. 160 p, 401 Ref. OWRT B-077-ALA(1), 14-34-0001-9055.

Descriptors: *Permits, *Legislation, *Water law, *State governments, *Mineral industry, Administration, Legal aspects, Social aspects, Environmental effects, *Alabama, Pennsylvania, Water policy, Control, Mapping, Federal jurisdiction, Water quality, Coal mines, Coal mine wastes, Oil industry, Natural gas, Water conservation.

The United States is presently embarked on a crash program to produce as much oil, gas, and coal as is possible in the shortest amount of time and this development involves many economic, social and environmental considerations. This report focuses on the problems faced by coal producers--legal control of water pollution and the clashes between mineral development and water use. The legal situation of coal producers in Alabama and Pennsylvania are discussed in detail and significant court cases, administrative controls, and Federal controls aare outlined. The coal and oil extraction industries cannot be relied upon to produce effective water policies, but the administration of these laws must be handled fairly and with the realization that rapid mineral development is necessary and that some evolution of the laws will occur. Jurisdictional limits and authority to grant permits must be set and this first involves the complete mapping of all mines and wells. It is recommended that Congress exempt certain oil and gas disposal wells from the Safe Drinking Water Act. Also it is suggested that the Alabama Legislature revamp its definitions of pollution and pass legislation which would give authority to municipalities to investigate suspected polluters. (Sidney-IPA).
W80-06322

GROUND WATER RESOURCE MANAGEMENT IN KANSAS,
Kansas Ground Water Management Districts Association, Topeka.
For primary bibliographic entry see Field 4B.
W80-06421

RESOURCES DATA

7A. Network Design

RECIPROCAL-DISTANCE ESTIMATE OF POINT RAINFALL,
Science and Education Administration, Tucson, AZ. Southwest Rangeland Watershed Research Center.
For primary bibliographic entry see Field 2B.
W80-06296

AN APPROACH TO MARGINAL ECONOMIC ANALYSIS OF HYDROMETRIC DATA COLLECTION,
Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
T. A. McMahon, and D. L. R. Cronin.
Water Resources Bulletin, Vol 16, No 3, p 414-420, June 1980. 4 Fig, 1 Tab, 21 Ref.

Descriptors: *Hydrologic data, *Stream gages, *Networks, *Cost-benefit analysis, *Canada, Economics, Surveys, Model studies, Mathematical models, Operating costs, Cost analysis, Streamflow, Data collections, Floods, Flood peak, Hydrology.

A procedure for computing the benefit/cost ratio of a hydrometric network was outlined. It consisted of two steps: firstly, establishing a relationship between hydrometric station density and error in hydrologic parameters and secondly, relating hydrologic error to changes in project cost. The procedure was applied to both the whole Canadian hydrometric network and the provincial networks. (Sims-ISWS)
W80-06310

HYDROLOGIC NETWORKS: INFORMATION TRANSMISSION,
British Columbia Univ., Vancouver. Dept. of Civil Engineering.
W. F. Caselton, and T. Husain.
Journal of the Water Resources Planning and Management Division, American Society of Civil Engineers, Vol 106, No WR2, Proceedings Paper 15572, p 503-520, July 1980. 4 Fig, 3 Tab, 9 Ref, 2 Append.

Descriptors: Design, Design criteria, *Networks, *Network design, Entropy, Estimating, Hydrology, Data collections, Information retrieval, Instrumentation, Optimization, Rainfall, Spatial distribution, Mathematical models, Model studies, Watersheds(Basins), Methodology, Communication, *Data transmission, *Information transmission, *Hydrologic networks.

A hydrologic data collection network was considered to be a component of a communication channel conveying regional hydrologic information. A measure of the information transmission by the hydrologic network, in conjunction with spatial estimators, was derived using Shannon's information theory. The resulting measure confirms that the network information transmission is dependent upon the joint entropy of the network station output but independent of the spatial estimators. Maximum information transmission was proposed as a criterion for the selection of station locations for a permanent network. A numerical example, involving the selection of station locations for various sizes of optimal information transmission hydrologic networks, was given. (Preece-ISWS).
W80-06386

GEOLOGY AND HYDROGEOLOGY OF THE BECHER POINT LINE AND GEOLOGICAL REINTERPRETATION OF ADJACENT BOREHOLE LINES,
For primary bibliographic entry see Field 2F.
W80-06417

HYDROGEOLOGY OF THE ENEABBA BOREHOLE LINE,
For primary bibliographic entry see Field 2F.
W80-06418

ORGANIZING TO COPE WITH HAZARDOUS MATERIAL SPILLS,
Ryckman's Emergency Action, St. Louis, MO.
For primary bibliographic entry see Field 5B.
W80-06419

7B. Data Acquisition

MODIFICATION OF TEMPE PRESSURE CELL FOR THE MEASUREMENT OF SATURATED HYDRAULIC CONDUCTIVITIES,
Department of Agriculture, Lethbridge (Alberta).
C. J. Palmer, and R. W. Blanchar.
Soil Science Society of America Journal, Vol 44, No 2, p 430-431, March-April 1980. 2 Fig, 5 Ref. OWRT A-101-MO(1).

Descriptors: *Hydraulic conductivity, *Permeability, *Laboratory equipment, Soils, Saturation, Saturated soils, Soil water, Soil water movement, Laboratory tests, Equipment, Instrumentation, Soil properties, Soil physics, Soil science, Pressure cells.

The Tempe pressure cell, which is used in studies of moisture retention, was evaluated for the measurement of saturated hydraulic conductivities. By the simple addition of a groove and O-ring, the pressure cell was altered so that it would hold a vacuum. This modification allowed for complete saturation of the soil cores and prevented the adverse effects of entrapped air on the saturated hydraulic conductivity measurement. The ability of the cell to function in its original purpose was not altered. The multiple use of this cell may allow for monetary savings in equipment purchases. (Sims-ISWS).
W80-06252

INVESTIGATIONS OF THE RADAR ECHO CLIMATOLOGY OF SOUTHERN HIPLEX,
Texas A and M Univ., College Station, TX. Dept. of Meteorology.
For primary bibliographic entry see Field 2B.
W80-06302

EVALUATION OF REMOTE HYDROLOGIC DATA-ACQUISITION SYSTEMS, WEST CENTRAL FLORIDA,
Geological Survey, Tallahassee, FL, Water Resources Div.
J. F. Turner, Jr., and W. M. Woodham.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-176951, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water Resources Investigations 79-102, 1980. 63 p, 13 Fig, 21 Tab, 6 Ref.

Descriptors: *Evaluation, *Hydrologic data, *Data collections, *Florida, *Satellites(Artificial), Analytical techniques, Telemetry, Instrumentation, Streamflow, Sites, Testing procedures, Rainfall, Data transmission, Remote sensing, *Southwest Florida Management District, GOES, *Landsat, Land-line system.

The study provides an evaluation of the hydrologic applications of a land-line and two satellite data-relay systems operated during 1977-78 in the Southwest Florida Water Management District. These systems were tested to evaluate operational and reliability characteristics. Telephone lines were used to relay data in the land-line system, and the Geostationary Operational Environmental Satellite (GOES) and Land satellite (Landsat) were used in the satellite system. The land-line system was tested for 15 months at a streamflow site. Accurate data were obtained 94% of the time during the test period. Data losses were attributed to telephone-line interference, low-battery voltage, and vandalism. The GOES system was tested at a rainfall site for 17 months. During this period, 79% of the transmissions received from the station were relayed by the GOES system to the U.S. Geological Survey computer, resulting in successful processing of 88% of all possible rainfall observations. On the average, seven data transmissions were completed each day. The Landsat system was tested at a rainfall site for about 17 months and for about 8 months at a streamflow site. During these periods of operation, only about 2% of all data observations for the stations were successfully relayed by the Landsat system to the U.S. Geological Survey computer. An average of about three data transmissions was completed each day for each site. (USGS).
W80-06345

SURFACE WATER INVENTORY THROUGH SATELLITE SENSING,
National Remote Sensing Agency, Hyderabad (India).
S. Thiruvengadachari, P. S. Rao, and K. R. Rao.
Journal of the Water Resources Planning and Management Division, American Society of Civil Engineers, Vol 106, No WR2, Proceedings Paper 15563, p 493-502, July 1980. 6 Fig, 1 Tab, 5 Ref, 2 Append.

Descriptors: *Remote sensing, *Water resources, *Surface waters, Mapping, Lakes, Reservoirs, Surveys, *Satellites(Artificial), Census, Foreign research, Foreign countries, Monitoring, Water management(Applied), *India, *Tamil Nadu(India).

Data collected by the earth resources satellite were used to develop a regression model through which surface water storage volume for ungaged water bodies or an area can be estimated from corresponding satellite-derived waterspread area. Field data on storage volume for 17 reservoirs in Tamil Nadu State in India and data from Landsat (formerly, Earth Resources Technology Satellite) on different dates were used in the development of the model. The satellite-derived waterspread area is able to account for 83% of the variation in storage volume. Surface water monitoring and inventory through this model has potential application in irrigation and groundwater development and management programs. (Humphreys-ISWS).
W80-06387

DEVELOPMENT OF A SELF-SEALING RAIN SAMPLER FOR ARID ZONES,
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Inst. for Desert Research.
For primary bibliographic entry see Field 2B.
W80-06393

GROUND WATER: THE SEISMOLOGIST'S TOOL OF THE FUTURE,
National Water Well Association, Worthington, OH.
T. E. Gass.
Water Well Journal, Vol 34, No 7, p 38-41, July 1980. 5 Fig.

Descriptors: *Water level fluctuations, *Water chemistry, *Seismology earthquakes, Groundwater, Forecasting, Artesian wells, Nuclear explosions.

Changes in water levels and water quality in wells can be used to predict the location and intensity of earthquakes. However, water level fluctuations in artesian wells must first be corrected for changes in atmospheric pressure and earth tides before they can be used to delineate different types of seismic waves from earthquakes and underground nuclear explosions. Wells penetrating artesian aquifers with high transmissivities and storage coefficients tend to provide favorable data for earthquake delineation. Years of careful observation of water level fluctuations in many wells over a wide area are necessary to predict the location, magnitude and data of an earthquake. Long-term changes in the concentrations of helium and radon in ground water also occur prior to an earthquake. Scientists at Cal Tech and other universities are developing well monitoring programs in earthquake-prone areas of California. Additional research is needed to determine the mechanics of ground water changes occurring prior to an earthquake. (Purdin-NWWA).
W80-06424

7C. Evaluation, Processing and Publication

WATER RESOURCES DATA FOR MINNESOTA, WATER YEAR 1979--VOLUME 1. GREAT LAKES AND SOURIS-RED-RAINY RIVER BASINS.
Geological Survey, St. Paul, MN. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-202963, Price codes: A12 in paper copy, A01 in microfiche. Geological Survey Water-Data Report MN-79-1, April 1980. 267 p, 7 Fig, 1 Tab.

Descriptors: *Minnesota, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, Great Lakes, *Tributaries to Lake Superior, *Red River of the North basin(MN), *Lake of the Woods basin(MN).

Water-resources data for the 1979 water year for Minnesota consist of records of stage, discharge, and water quality of streams, stage, contents, and water quality of lakes and reservoirs; and water

levels and water quality in wells and springs. This volume contains discharge records for 65 gaging stations; stage-only records for 1 gaging station; stage and contents for 5 lakes and reservoirs; water quality for 19 gaging stations, 1 partial-record station, and 13 lakes; and water levels for 39 observation wells. Also included are 48 crest-stage partial-record stations and 21 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data, together with the data in volume 2, represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Minnesota. (USGS)
W80-06236

WATER RESOURCES DATA FOR MICHIGAN, WATER YEAR 1979,
Geological Survey, Lansing MI. Water Resources Div.
Geological Survey Water-Data Report MI-79-1, May 1980. 525 p, 9 Fig.

Descriptors: *Michigan, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites.

Water resources data for the 1979 water year for Michigan consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water temperature of ground water. This report contains discharge records for 175 gaging stations, stage only records for 1 gaging station, stage and contents for 5 lakes and reservoirs, water quality for 62 continuous-record stations, and water levels for 46 observation wells. Also included are 94 crest-stage partial-record stations and 45 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Michigan. (USGS)
W80-06237

WATER RESOURCES DATA MINNESOTA, WATER YEAR 1979--VOLUME 2. UPPER MISSISSIPPI AND MISSOURI RIVER BASINS,
Geological Survey, St. Paul, MN. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-203169, Price Codes: A19 in paper copy, A01 in microfiche. Geological Survey Water-Data Report MN-79-2, April 1980. 432 p, 8 Fig, 1 Tab.

Descriptors: *Minnesota, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, *Upper Mississippi River basin(MN), *Missouri River basin(MN).

Water-resources data for the 1979 water year for Minnesota consist of records of stage, discharge, and water quality of streams, stage, contents, and water quality of lakes and reservoirs; and water levels and water quality in wells and springs. This volume contains discharge records for 76 gaging stations, stage and contents for 9 lakes and reservoirs; water quality for 39 gaging stations, 2 partial-rcord stations, 7 lakes and 10 wells; and water levels for 214 observation wells. Also included are 111 crest-stage partial-record stations and 85 low-flow stations and 85 low-flor partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data, together with the data in volume 1, represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Minnesota. (USGS)
W80-06238

AVAILABILITY OF GROUND WATER IN THE LOWER CONNECTICUT RIVER BASIN, SOUTHWESTERN NEW HAMPSHIRE,
Geological Survey, Concord NH. Water Resources Div.
J. E. Cotton.
Geological Survey Water-Resources Investigations 77-79 (open-file report), 1977. 1 Sheet, 9 Ref.

Descriptors: *Groundwater availability, *New Hampshire, *Aquifers, *Water quality, Groundwater resources, Maps, Regional analysis, Water wells, Well data, Water yield, *Lower Connecticut River basin(NH).

This map scale 1:125,000 presents a preliminary assessment of the availability of ground water in the lower Connecticut River basin in southwestern New Hampshire. It is a generalization of several hydrogeologic factors and provides a guideline for ground-water exploration useful in water- and land-use planning. It does not describe the absolute quantity or quality of ground water available. The best aquifers in the basin are deposits of stratified sand or sand and gravel of Pleistocene age. Large aquifers of this type occur in places in the Connecticut River valley and in valleys of tributaries to the Connecticut River. Ground water is generally of good chemical quality. Iron and manganese in concentrations greater than the recommended limits for drinking water suggested by the U.S. Public Health Service are not uncommon. (USGS).
W80-06249

A DISTANCE-WEIGHTED METHOD FOR COMPUTING AVERAGE PRECIPITATION,
Regional Engineering Coll, Silichar, (India). Dept. of Civil Engineering.
S. M. Goel, and A. S. Aldabagh.
Journal of the Institution of Water Engineers and Scientists, Vol. 33, No. 5, p 451-454, September 1979. 5 Fig, 1 Tab, 4 Ref.

Descriptors: *Precipitation (Atmospheric), *Watersheds (Basin), *Analytical techniques, *Hydrology, Analysis, Average, Networks, Data processing, Isohyets, Rainfall, Rain gages, Average rainfall, Thiessen polygon, Weighted average.

In planning almost all water resources projects it is necessary to calculate the average precipitation over a basin for which rain gage network and rainfall measurements are known. The current methods in use are: (1) arithmetical mean, (2) Thiessen polygon, and (3) isohyetal. Rainfall recorded at a gage station depends upon various factors such as elevation of the gage station, windward and leeward faces of hilly terrain, vegetal cover on the area, and the slope of the area. Therefore, to arrive at a reasonable estimate of average precipitation, these factors must be weighted. The isohyetal method considers such factors by modifying the isohyets. The Thiessen polygon method weights areal distribution by allotting a part of the area to each station. In the proposed new method, the change in rainfall intensity between two stations is assumed to be the result of changes in geomorphological conditions between the stations, and it is further assumed that the geomorphological changes are such that the resulting change in rainfall intensity is directly proportional to the distance between the two stations. This avoids the necessity of determining areal distribution graphically. Only the distances between neighboring stations are measured. The length of each line is measured and multiplied by the arithmetic mean of the rainfall at the stations at each end. Only those lines which lie 50% or more within the catchment area are considered. The products are summed and divided by the total lengths of all the lines considered to give the resultant average precipitation over the basin. The results obtained using the distance-weighted method were closer to the results of the isohyetal method than those obtained by the Thiessen polygon method. (Humphreys-ISWS).
W80-06291

NONPOINT-SOURCE DISCHARGES IN PEQUEA CREEK BASIN, PENNSYLVANIA, 1977,
Geological Survey, Harrisburg, PA, Water Resources Div.
For primary bibliographic entry see Field 5A.
W80-06346

DRAINAGE AREAS OF STREAMS IN ARKANSAS, OUACHITA RIVER BASIN,
Geological Survey, Little Rock, AR, Water Resources Div.
J. J. Yanchosek, and M. S. Hines.
Available from OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $11.50 in paper copy, $3.50 in microfiche. Geological Survey open-file report 80-334, 1979. 87 p, 1 Fig, 1 Tab, 6 Ref.

Descriptors: *Drainage area, *Streams, *Arkansas, *Watersheds(Basins), Data collections, Runoff, Surface waters, *Ouacita River basin(AR).

Drainage areas, determined in accordance with procedure recommended by the Subcommittee on Hydrology of the Federal Inter-Agency River Basin Committee, are listed for points on streams in the Ouachita River basin in Arkansas. Points on the streams are identified by some topographic feature and by latitude and longitude. (USGS).
W80-06349

WATER-RESOURCES INVESTIGATIONS IN TEXAS, FISCAL YEAR 1980.
Geological Survey, Austin, TX. Water Resources Div.
Geological Survey Texas District report, February 1980. 32 p, (Compiled by Buckner, H. D. and Mitchell, A. A.).

Descriptors: *Hydrologic data, *Data collections, *Texas, *Projects, Surface waters, Groundwater resources, Water quality, Streamflow, Sediment transport, Reservoirs, Water wells, Aquifers, Drawdown, Land subsidence, Water levels, Estuaries, Tides, Chemical analysis, Sampling, Sites, Maps, Flood plains, Cooperatives.

This report describes the water-resources projects and activities of the Geological Survey in Texas for the 1980 fiscal year (October 1, 1979, to September 30, 1980). A continuing series of measurements and quantitative analyses are made of streamflow, reservoir contents, and estuarine flow. In addition, data are collected on the chemical quality of water and sediment in streams and reservoirs, water levels in wells, and land-surface subsidence. By the end of the 1980 fiscal year, the following installations will be in operation: Approximately 677 digital recorders at stream-gaging tide-level, and rainfall stations; 15 conductivity (digital) recorders; 5 instruments for continuously monitoring and recording the water-quality characteristics of conductivity, water temperature, dissolved oxygen, and pH; and 6 continuous recorders for water temperature. Ground-water data are collected at more than 1,300 observation wells. Water levels are measured continuously in 34 wells and periodically in 1,005 wells; chemical-quality data are collected in 317 wells; and subsidence data are collected in 13 wells. (USGS)
W80-06352

APPROXIMATE WATER-LEVEL CHANGES IN WELLS IN THE CHICOT AND EVANGELINE AQUIFERS IN THE HOUSTON-GALVESTON REGION, TEXAS, 1977-80 AND 1979-80,
Geological Survey, Houston, TX. Water Resources Div.
R. K. Gabrysch, and C. E. Ranzau, Jr.
Available from OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $1.00 in paper copy, $3.50 in microfiche. Geological Survey open-file report 80-337, March 1980. 4 Sheets, 1 Ref.

Descriptors: *Water level fluctuations, *Water wells, *Aquifers, *Groundwater, *Compaction, Land subsidence, Maps, Texas, *Chicot aquifer(TX), *Evangeline aquifer(TX), *Harris County(TX), *Galveston County(TX).

This report consists of four maps that present data on water-level changes during 1977-80 and 1979-80 in the Chicot and Evangeline aquifers in the Houston-Galveston region, Texas. Water levels in about 550 wells were used to construct the maps. (USGS).
W80-06360

GROUND-WATER STATUS REPORT, PEARL HARBOR AREA, HAWAII, 1978,
Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 2F.
W80-06362

DEPTH TO THE WATER TABLE IN THE COLORADO SPRINGS--CASTLE ROCK AREA, FRONT RANGE URBAN CORRIDOR, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W80-06363

WELL YIELDS AND CHEMICAL QUALITY OF WATER FROM WATER-TABLE AQUIFERS IN THE COLORADO SPRINGS--CASTLE ROCK AREA, FRONT RANGE URBAN CORRIDOR, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W80-06364

STREAMFLOW AND RESERVOIR-CONTENT RECORDS IN TEXAS, COMPILATION REPORT, JANUARY 1889 THROUGH DECEMBER 1975,
Texas Dept. of Water Resources, Austin.
J. P. Dougherty.
Report 244 (3 volumes), 1980. 1020 p, 3 Map.

Descriptors: *Data collections, *Texas, *Streamflow, *Rio Grande River, *Colorado River, *River basins, Watersheds(Basins), Reservoirs, Gaging stations, Discharge(Water), *Reservoir storage, Monthly, Annual, Average, Canadian River, Red River, Sulphur River, Cypress Creek, Sabine River, Neches River, Trinity River, San Jacinto River, Brazos River, Lavaca River, Guadalupe River, San Antonio River, Nueces River.

The primary purpose of this 3-volume report was to present a complete compilation of available historical monthly streamflow and reservoir-content records that have been obtained in Texas, spanning an 87-year period from January 1889 through December 1975. The data compiled represent a total of 825 gaging stations and consist of records of the monthly discharge of streams, canals, floodways, and end-of-month contents of reservoirs in Texas, summarized on a monthly and calendar year basis. Compiled are the records of 693 streamflow stations, 28 canal stations, 9 floodway stations, and 86 reservoir-content stations. In addition, streamflow records are shown for 7 stations in New Mexico and 1 each in the states of Oklahoma and Arkansas. The station description gives the location of the gaging station, drainage area where applicable, period of record, gage type and datum, average discharge, extremes of discharge, and general remarks. Volume 1 presents tabulated data for gaging stations in the Canadian, Red, Sulphur, Cypress Creek, Sabine, Neches, Trinity, and San Jacinto basins and adjoining coastal basins. Volume 2 presents tabulated data for gaging stations in the Brazos and Colorado basins and adjoining coastal basins. Volume 3 presents tabulated data for gaging stations in the Lavaca, Guadalupe, San Antonio, Nueces, and Rio Grande basins and adjoining coastal basins. (Humphreys-ISWS).
W80-06375

RAINFALL TREND AT PORT MORESBY FROM 1945 TO 1976,
National Weather Service, Papua (New Guinea).
For primary bibliographic entry see Field 2B.
W80-06408

FAULT ZONE CONTROLLED CHARGING OF A LIQUID-DOMINATED GEOTHERMAL RESERVOIR,
Colorado Univ. at Boulder. Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 2F.
W80-06427

ENGINEERING WORKS

8A. Structures

DAMS AND PUBLIC SAFETY,
Water and Power Resources Service, Denver, CO.
R. B. Jansen.
Available from U.S. Government Printing Office, Washington, D.C. 20402 Stock No 024-003-00138-4. A Water Resources Technical Publication, 1980. 344 p, 89 Fig, 1 Tab, 96 Ref.

Descriptors: *Dams, *Dam design, *Dam failure, *Safety, *Dam construction, Soil mechanics, Dam foundation, Foundation failure, Erosion, Seepage, Earthquakes, History, Failures, Uplift pressure, Earth dams, Rockfill dams, Foundation investigations, Engineering geology, Evaluation, Assessments, Inspection.

The history of dams and their associative safety problems are discussed in this book. Suggestions are made for the effective management of the problems that may develop at dams and reservoirs based on the lessons learned from past dam failures. The development of dam engineering techniques are outlined from the period B.C. to the twentieth century. Dams in general require defensive engineering and the inseparable relationship of design and construction must be recognized. The design should be developed after careful theoretical studies and consideration of past dam failures. The kinds of problems which may occur include seepage, erosion, deterioration, and earthquakes. Forty-one examples of significant dam accidents and failures are discussed and practical solutions for the problems are outlined such as seepage control, engineering of conduits and structures, and surveillance. Preventative and remedial engineering relies heavily on field examination of the dams and reservoirs. A glossary of dam terminology appears at the end. (Sidney-IPA)
W80-06227

SCREEN SYSTEM COULD SPELL END OF GRAVEL PACKS.
World Water, Vol 3, No 4, p 37, April 1980. 1 Fig.

Descriptors: *Well screens, *Well filters, *Plastic pipe, Clogging, Gravel packs, Sand aquifers.

A new type of well screen, the hydrotec screen, is designed for use with any type of slotted or drilled nonmetallic pipe. It consists of three layers: an outer cover which is abrasion-resistant, non-degradable and chemically inert; a polypropylene woven filter fabric specifically designed for soil filtration; and an inner cover of very course ribbed plastic which acts as a conducting system to ensure equal distribution of water to the receiving pipe slots or holes. This screen may replace gravel packs for wells in fine sand aquifers since it is very resistant to clogging. (Purdin-NWWA).
W80-06414

DRILLER TRAINING LEADS SWEDES' ASSAULT ON WATER MARKET,
World Water, Vol 3, No 4, p 34-36, April 1980. 1 Fig, 1 Tab.

Descriptors: *Drilling, *Training, *Technology, *Water wells, Engineering, Education, Boreholes, Pumps, Drilling fluid, Rotary drilling, Percussion drilling.

Atlas-Copco has developed a complete water well drilling training package for contractors, consultants or client organizations. The course is based on a comprehensive water-well drilling manual, which includes self-administered tests on selecting the right hole diameter, pumping equipment, drilling technique, drilling fluid, and rig for specific sites and water requirements. Reduced bit wear, better directional control and faster penetration rate favor 'down-the-hole' (HTH) drilling over rotary crushing and top hammer drilling for water wells in hard rock. Hole diameter is generally fixed by the pumping equipment needed to raise the required amount of water. The smallest possible hole diameter will be the most economical development. Foam is recommended as the most desirable drilling fluid, except in cases of high formation water, where mud should be used. High operating pressures are recommended to provide the extra feed force needed below water and the necessary flushing capability. Atlas-Copco also provides special training courses for potential rig operators beginning with basic hydraulics and electronics and progressing through rig operation and maintenance. (Purdin-NWWA).
W80-06416

FOUR FLOODS ALMOST WRECK COFFER DAMS.
Civil Engineering Contractor (Johannesburg) Vol 13, No 6, p 43, 45, and 47, March 1979. 4 Fig.

Descriptors: *Floods, *Flood damage, *Coffer dams, *Bridge construction, *Formwork(Construction), Repairing, Rock foundations, Silts, Stability, Leakage, Sealants, Pontoons, Sheet piling.

During the two and a half years of construction of a two-way double freeway bridge over the Vaal River between Vanderbiil and Sasol, South Africa, problems were encountered due to four 50-year floods. Silt covering the Andesite rock was washed away posing two major problems -- the stability and sealing of the dam coffers. To overcome these problems different methods were used on each coffer dam. Two basic methods which evolved were: placing sand bags 1.5 m deep on the bare rock of the river bed where the coffer dam was to be constructed, to seal and to provide stability; and 'double-skinning' the entire coffer dam by using two rows of sheet piles one meter apart with silt placed in between to provide a seal. At a later point in construction, flooding caused leaks in the frames. Four methods were used to repair the leaks: sandbags, double-skinning, redumping silt inside the coffer dam, and using concrete on the inside and outside. At one point during the flooding, one coffer dam washed away and had to be salvaged and reinstated, and the pontoon sank with all the equipment aboard. (Stiles-IPA).
W80-06450

8B. Hydraulics

BOUNDARY LAYERS IN DEVELOPING OPEN CHANNEL FLOW,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
E. Silberman.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY7, Technical Note, p 1237-1241, July 1980. 2 Fig, 9 Ref, 2 Append.

Descriptors: *Open channel flow, *Flow, *Boundary layers, *Mathematical models, Hydraulics, Theoretical analysis, Analytical techniques, Critical flow, Flow characteristics, Boundary layer development, Developing flow, Channel entrance.

Developing flow in open channels may be analyzed using the Bernoulli and continuity equations and by taking boundary layer growth into account. Following flow contraction near a channel entrance, fresh boundary layers fom around the channel perimeter. Outside the boundary layers, the flow may be assumed to be nearli potential. In this nearly potential region, the Bernoulli equation is valid. As flow progresses downstream, less of the cross-section is fitted by the Bernoulli equation until, at some distance from the entrance, the boundary layer reaches the surface near the channel center. This analysis is applicable only until that point is reached; thereafter, fully developed flow occurs and the usual methods of analysis for

fully developed flow are more suitable. Unforunately, the entrance to an open channel does not ususally have a well-defined leading edge. The displaced layer may begin with separated flow. In view of the difficulty in defining entry conditions, it is futile to attempt a precise calcultion for displaced boundary thickness. A good guess, guided by rough boundary layer calculations, it the most that can be hoped for; often even that is impossible. Complicated boundary layer analysis is not warranted for a channel entrance. (Humphreys-ISWS)
W80-06297

FORCE ON SILL OF FORCED JUMP,
Manchester Univ., (England). Dept. of Civil and Structural Engineering.
R. Narayanan, and L. S. Schizas.
Journal of the Hyraulics Division, American Society of Civil Engineers, Vol 106, No HY7, Proceedings Paper 15552, p 1159-1172, July 1980. 11 Fig, 14 Ref. 2 Append.

Descriptors: *Hydraulic jump, *Loads(Forces), *Model studies, *Hydraulic structures, Laboratory tests, Energy dissipation, Baffles, Flow, Hydraulics, Mathematical models, Flow characteristics, Analytical techniques, Standing wavers, Submergence, Drag, Tailwater, Forced jump.

The mean force on a continuous sill in a forced hydraulic jump was measured directly by a transducer for a wide range of experimental conditions. Four sills of heights expressed as multiples of the sluice opening were 1.0, 1.5, 2.0, and 3.0. The Froude number based on the flow at the sluice opening was varied from 3.99 to 9.09. The sills were situated at various distances from the sluice gate. The state of the flow is governed by the depth downstream of the sill. Maximum force is exerted when the super-critical stream impinges directly on the sill. The force reaches an asymptotic value at high submergence, and it could be predicted for high sills using an elementary dynamic pressure model. (Humphreys-ISWS)
W80-06299

MULTIOBJECTIVE STATISTICAL METHOD FOR INTERIOR DRAINAGE SYSTEMS,
Case Western Reserve Univ., Cleveland, OH. Systems Engineering Div.
Y. Y. Haimes, K. A. Loparo, S. C. OLenik, and S. K. Nanda.
Water Resources Research, Vol 16, No 3, p 465-475, June 1980. 2 Fig, 1 Tab, 11 Ref, 2 Append.

Descriptors: .

In this design of a levee drainage system was formulated as a multiobjective optimization problem in a probabilistic framework. The statistical nature of the problem was reflected by the probabilistic behavior of rainfall and river stage events in any given month. The multiobjective approach allowed for the incorporation of noncommensurable objectives such as aesthetics, economics, and social issues into the optimization problem, providing a more realistic quantification of the impact of a flood or high water situation in an interior basin. A new method referred to as the multi-objective statistical method, which integrates statistical attributes with multiobjective optimization methodologies such as the surrogate worth trade-off method, was developed in this paper. A case study using data from the Moline area in Illinois suggested the use of the procedure. (Sims-ISWS)
W80-06311

THE USE OF BEST AVAILABLE AND SAFEST TECHNOLOGIES (BAST) DURING OIL AND GAS DRILLING AND PRODUCING OPERATIONS OF THE OUTER CONTINENTAL SHELF (OCS). PROGRAM FOR IMPLEMENTING SEC. 21(B) OCS LANDS ACT AMENDMENTS OF 1978,
Geological Survey, Reston, VA.
Report April 1980. 26 p, 2 Fig, Append.

Descriptors: *Safety regulations, *Drilling, *Oil fields, Water pollution control, Pollution abatement, Resources development, Environmental effects, Offshore platforms, Technology, United States, *Outer Continental Shelf.

The best available and safest technologies (BAST) program provides a systematic approach toward the incorporation of various program elements into an overall OCS regulatory scheme. Recognizing the evolutionary nature of the BAST program, as improvements, additions, and advances are made in safety concepts and technology, changes will be made to the existing body of regulations, Orders, and standards which govern the extraction of minerals for OCS leased lands. Although many BAST standards are applicable to the entire OCS, it is recognized that the application of BAST must be tailored to each Region's geological and environmental condition, and its application must also be suited to the type of operation. The USGS activities and programs are designed to identify and report equipment hazards and problems, assure that all safety and pollution-prevention equipment used on the OCS is as effective and reliable as possible, insure that workers are adequately trained and qualified for their jobs, monitor and encourage research and development in safety and environmental protection, and provide for rigorous inspection of operator facilities and enforcement of all applicable directives. (Sinha-OEIS)
W80-06316

8C. Hydraulic Machinery

DRILLER TRAINING LEADS SWEDES' ASSAULT ON WATER MARKET,
For primary bibliographic entry see Field 8A.
W80-06416

GROUND WATER HEAT PUMPS IN WISCONSIN,
Geological Survey, Madison, WI.
J. Connelly.
Water Well Journal, Vol 34, No 7, p 49, July 1980.

Descriptors: *Heat pumps, *Groundwater, *Wisconsin, Economic feasibility, Environmental effects, Cost comparisons, Heating, Water temperature.

The Wisconsin Geological and Natural History Survey (WGNHS) is studying the economic feasibility and environmental impact of using ground water heat pumps for domestic heating and cooling. The saving in annual heating cost for a 3,000 square foot, well insulated home was found to be about $586. The shallow ground water temperature ranges from 44 degrees F in the north to 54 degrees F in the south. The WGNHS final report will include an energy cost comparison, a ground water temperature map, and a map showing potential areas where ground water heat pumps could be used in Wisconsin. (Purdin-NWWA).
W80-06423

HIGH-SPEED BIT REDUCES COSTS-PER-FOOT.
Drilling-DCW, Vol 41, No 7, p 62, April 15, 1980. 1 Fig.

Descriptors: *Rotary drilling, *Operating costs, *Penetration, *Drilling bits, Bearings, Sealants, Lubricants.

The high speed 51 rotary bit at 140 rpm has increased the penetration rate and reduced the cost-per-foot by as much as 45 percent in soft formations along the Gulf Coast. This is due primarily to an improved bearing system and other advances such as solid lubricants, improved cutting structure and a radial seal. Another approach to reduce operating cost was to reduce the time spent tripping the drill string since almost 39 percent of the total operating time is spent in such nonproductive activities. With this bit, the operator can run at high rotary speeds in softer formations or switch to heavier weights and conventional rpm's when harder formations are encountered. At conventional speeds it will last 2.15 to 3 times longer due to the improved bearing system. (Purdin-NWWA).
W80-06425

8I. Fisheries Engineering

CONNECTICUT RIVER FISHWAYS: MODEL STUDIES,
Worcester Polytechnic Inst., Holden, MA. Alden Research Labs.
D. K. White, and B. J. Pennino.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY7, Proceedings Paper 15554, p 1219-1233, July 1980. 11 Fig, 4 Ref, 2 Append.

Descriptors: *Fish handling facilities, *Hydraulic structures, *Model studies, *Connecticut River, *Fish passages, Hydraulic models, Laboratory tests, Flow characteristics, Conveyance structures, Fish guiding, Intakes, Weirs, Flow rates, Flow control, Atlantic salmon, Hydraulic design, Fish, *Turner Falls Dam(CT), *Vernon Falls Dam(CT), Diffuser, Shad.

The fishways at the Vernon and Turners Falls Dams were optimized by use of hydraulic model studies. In both cases, slotted weirs were modified so that a better head loss distribution was obtained. In addition, the diffusers were modified to produce acceptable exit face velocity distributions. At Turners Falls, the fish entrance was modified to produce velocity conditions known to be acceptable to the two migrating species of fish, Atlantic salmon and shad. At Vernon Dam, flow conditions were optimized at the fish exit and attraction water intake. Modeling of these fishways has resulted in design changes that should improve fish passage and minimize water consumption. (Humphreys-ISWS).
W80-06382

MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

PERSPECTIVE ON GEOGRAPHICAL RESEARCH: (11) HYDROLOGY IN GEOGRAPHIC PERSPECTIVE IN SOUTH AFRICA,
Natal Univ., Pietermaritzburg (South Africa).
R. E. Schulze.
South African Geographer (Dennesig Stellenbosch), Vol 5, No 6, p 495-503, 1977. 53 Ref.

Descriptors: *Hydrology, *Research priorities, *Geographical regions, *Education, *Water resources, Research facilities, Hydrologic cycle, Hydrologic systems, Semiarid climates, Hydrologic properties, Physical properties, Universities, Social aspects, Demonstration watersheds, Engineering education, Training, Systems analysis, Forecasting, Planning, Research and development, Simulation analysis, Operations research, *South Africa.

The relationship between geography and hydrology, particularly in South Africa, is emphasized. This perspective is of great importance to water-scarce South Africa, since the disciplines need to be coordinated to meet the severe hydrological problems South Africa will face in the future. The science of hydrology is defined as being an understanding and a description of natural processes involving the water cycle, and production of information to be used for water resource planning. Both physical geography and hydrology have moved toward relevance and the application of the systems concept. Hydrology should be an integral part of training in physical geography and more research should be focused on the real hydrological problems of South Africa. Geographers would also be able to view regional scale hydrological research from a spatial point of view and they could make positive contributions in research at the experimental catchment scale. Also emphasized is the need for a practical, problem-oriented program in hydrological training in South African universities. The training of hydrologists with a good understanding of hydrology and geographic concepts is essential for solving South Africa's water resources problem. (Sidney-IPA).

W80-06409

EFFECTIVENESS OF FIELD TRIPS IN TEACHING GROUNDWATER CONCEPTS,
Nebraska Univ., Lincoln. Dept. of Geology.
D. T. Pederson.
Journal of Geological Education, Vol 27, No 1, p 11-12, January 1978. 1 Fig.

Descriptors: *Groundwater, *Education, *On-site data collections, Universities, Groundwater movement, Mapping, Glacial aquifers, Confined aquifers, Artesian wells, Flow measurement, Base flow, Water temperature, Irrigation water, Nebraska.

Misconceptions about groundwater are perpetuated by ambiguous terminology and incomplete and misleading diagrams in elementary textbooks. To overcome this, the Geology Department at the University of Nebraska-Lincoln conducts one-day field trips to teach students basic data collection techniques, mapping skills, ground water occurrence and movement, and water use. The aquifer studied is a buried valley system under artesian pressure, and wells completed in the aquifer may flow at the surface. Students prepare a water-level contour map from data they collect and drillers logs. A pygmy meter is used to measure base flow. Specific conductance, pH, and water temperature of ground water and surface water are measured and compared. Water rights conflicts resulting from irrigation pumping are discussed. Comparison of pre-trip and post-trip test results show that one-day field trips are effective in teaching ground water concepts. (Purdin-NWWA).
W80-06415

DRILLER TRAINING LEADS SWEDES' ASSAULT ON WATER MARKET,
For primary bibliographic entry see Field 8A.
W80-06416

9D. Grants, Contracts, and Research Act Allotments

EFFECTIVE WATER RESEARCH PROGRAMS,
Texas Univ. at Austin. Center for Research in Water Resources.
L. R. Beard.
Journal of the Water Resources Planning and Management Division, American Society of Civil Engineers, Vol 106, No WR2, Proceedings Paper 15530, p 409-412, July 1980.

Descriptors: *Research and development, *Water resources, *Technology, Hydrology, Hydraulics, Water, *Contracts, Projects, Research priorities, Research programs, Research contracts, Proposals, *Research funding, Selection of researchers, Research management, Research coordination.

Effective research programs are those that support the most interested, informed, and competent researchers. In defining the problem to be researched, obtaining detailed data relative to that problem, and testing and applying the research results to the solution of that problem in actual practice, a practitioner is invaluable and should be a full partner in the research endeavor. In coordinating research, particularly interdisciplinary research, the lead researcher must be one who grasps the overall problem and understands enough of each discipline to coordinate the effort effectively. Over-coordination or over-direction by funding agencies can stifle progress because freedom to pursue a variety of ideas is generally more productive than is direction along the most promising course. Selection of researchers for contract or grant research projects on the basis of past performance as evaluated by users would appear to lend greater promise than selection by peer review, which tends to perpetuate current lines of scientific thought. (Sims-ISWS).
W80-06389

SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

DROUGHT IN THE GREAT PLAINS: A BIBLIOGRAPHY.
Nebraska University, Lincoln, NE, Agricultural Experiment Station, Institute of Agriculture and Natural Resources, Wilhite, D. A. and Hoffman, R. O., eds. (1979) 75 p, 1 Append. OPA-77-21289.

Descriptors: *Bibliographies, *Droughts, *Great Plains, Information retrieval, Information exchange, Data storage and retrieval, Publications.

A bibliography of scientific and general literature specific to drought in the Great Plains is presented. Great emphasis was placed on the precision of the citations which were assembled from scientific journals, books, reports, popular magazines, newspapers, and current research projects. Citations from computer bases were checked for accuracy and completeness. The Bibliography is divided into three sections for easy use: (1) reference listing; arranged alphabetically with assigned entry numbers in two sections--published materials and current research projects; (2) author index; arranged alphabetically; (3) subject index; arranged alphabetically by key words and including citation numbers for each entry. (Sidney-IPA)
W80-06231

10D. Specialized Information Center Services

DEFINITIONS OF COMPONENTS OF THE WATER DATA SOURCES DIRECTORY MAINTAINED BY THE NATIONAL WATER DATA EXCHANGE,
CACI, Inc., Reston, VA.
W. A. Knecht, and M. D. Edwards.
Available from OFSS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $14.50, microfiche $3.50. Geological Survey open-file report 79-1541, 1980. 106 p, 3 Fig, 9 Ref.

Descriptors: *Information retrieval, *Data storage and retrieval, *Organizations, *Water sources, *Publications, Documentation, Surface waters, Groundwater, Water quality, *National Water Data Exchange(NAWDEX), *Dictionary use information, *Data definitions, *System 2000, *Data base management systems, Data dissemination.

This report contains a definition and description of each component of the Water Data Sources Directory data base maintained by the National Water Data Exchange (NAWDEX). It is intended, primarily, to assist those persons using the Water Data Sources Directory in understanding information obtained from the data base. The Water Data Sources Directory is a computerized data base maintained and operated using the System 2000 data base management system. It contains information about organizations that collect, store, and disseminate water data. (USGS)
W80-06235

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A. CENTERS OF COMPETENCE		
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University of Florida, Eastern U. S. Water Law	W80-06256	1
University of North Carolina, Metropolitan Water Resources Planning and Management	W80-06259	1
B. STATE WATER RESOURCES RESEARCH INSTITUTES	W80-06201 06218--06223 06229 06254--06255 06260--06271 06318--06319 06327--06333 06365, 06410 06436--06437	35
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3 WATER SUPPLY AUGMENTATION AND CONSERVATION

4 WATER QUANTITY MANAGEMENT AND CONTROL

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A17	20.00	E17	42.50	T17	1,080.00
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